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PHYSICS ABSTRACTS

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LIST OF JOURNALS

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Physics Abstracts

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Photocells
Thermionic tubes
Cathode-ray tubes
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For the benefit of those who are unfamiliar with the form and purpose of such abstracting periodicals as "Science Abstracts", it may be said that each abstract is a summary of an article (or book) published elsewhere, the title of the article (or its English translation) being given at the beginning of the abstract. The "reference", printed immediately after the title and author, gives the name and date of the journal where the article was printed and the appropriate pages. In general, title, author and reference are usually required for the location of an article. For books, the town of publication, the name of the publisher, and the year are given in the reference.

The form of the "reference", giving volume number, issue number, pages and date, will, it is hoped, be self-explanatory. It should be emphasized that the date given refers, in nearly every case, to the "issue" or "number" containing the article abstracted; in some cases, particularly when papers are issued separately, the "volume" when bound may bear a different date. The date given is that recorded on the issue, not the actual date of publication or receipt, unless so stated. When the volumes carry no number, the year is given in its place.

If no indication of language is given in the abstract, the article may be assumed to be in English. This does not necessarily hold, however, for abstracts reproduced from other abstracting periodicals giving no indication of language.

A.C.E.C. Rev.
ACEC Revue. — Ateliers de Constructions Electriques de Charleroi, Rue Vital Francoisse, Marcinelle-Charleroi, Belgium.

A.E.G. Mitt.
AEG Mitteilungen. — Allgemeine Elektrizitäts-Gesellschaft, Hohenzollerndamm 150, Berlin-Grunewald.

A.T.E. J.
A.T.E. Journal. — Automatic Telephone and Electric Co., Strowger Works, Liverpool 7.

A.W.A. tech. Rev.
A.W.A. Technical Review. — Amalgamated Wireless Australasia, 554 Parramatta Road, Ashfield, Sydney.

Abhandl. Braunschw. Wiss. Gesell.
Abhandlungen der Braunschweigischen Wissenschaftlichen Gesellschaft. — Brunswick.

Abhandl. Dtsch. Akad. Wiss. Berlin, Kl. Math. Phys. Tech.
Abhandlungen der Deutschen Akademie der Wissenschaften, Klasse für Mathematik, Physik und Technik. — Published by: Akademie-Verlag, Mohrenstrasse 39, Berlin W.8.

Acta cryst.
Acta Crystallographica. — The International Union of Crystallography. Published by: Ejnar Munksgaard, Nörregade 6, Copenhagen. Additional subscription address: Polycrystal Book Service, 84 Livingston Street, Brooklyn 1, N.Y.

Acta electronica
Acta Electronica. — 23 Rue du Retrait, Paris XX^{e}.

Acta phys. Austriaca
Acta Physica Austriaca. — Springer-Verlag, Mölkerbastei 5, Vienna I.

Acta phys. Hungar.
Acta Physica Hungarica. — Magyar Tudományos Akadémia Könyvtára, Akadémia-utca 2, Budapest V.

Acta phys. Polon.
Acta Physica Polonica. — Polska Akademia Nauk, Publication address: PPK "Ruch", al Jerzolinski 119, Warsaw.

Acta polytechnica
Acta polytechnica. — The Royal Swedish Academy of Engineering Sciences; The Danish Academy of Technical Sciences; The Royal Norwegian Council for Scientific and Industrial Research; The Finnish Delegation for Coordinating Technical Research. Subscription address: Acta Polytechnica Publishing Office, Box 5073, Stockholm 5.

Acta tech. Hungar.
Acta Technica Academiae Scientiarum Hungaricae. — Magyar Tudományos Akadémia Könyvtára, Akadémia-utca 2, Budapest V.

Acustica.
Acustica. — S.Hirzel Verlag, Zürich.

Advances in Phys.
Advances in Physics. — Quarterly Supplement of the Philosophical Magazine. Taylor & Francis, Red Lion Court, Fleet Street, London, E.C.4.

Akust. Beih.
Akustische Beihefte. — Issued as a supplement under the auspices of the international journal Acustica. The pagination is continuous with that of Acustica.

Akust. Zh.
Akusticheskiĭ Zhurnal. — Akademiya Nauk SSSR, Moscow.

Allis Chalmers elect. Rev.
Allis Chalmers Electrical Review. — Allis Chalmers, Milwaukee 1, Wisconsin.

Alta Frequenza
Alta Frequenza. — Associazione Elettrotecnica Italiana, Via San Paolo 10, Milan.

Amer. J. Phys.
American Journal of Physics. — American Institute of Physics, 57 East 55th Street, New York 22.

Amer. Soc. Test. Mater. Bull.
American Society for Testing Materials. Bulletin — [Abstracted by the Electrical Research Association.]

An. Acad. Brasil. Ciênc.
Anais da Academia Brasileira de Ciências. — Caixa Postal 229, Rio de Janeiro.

An. Inst. Fís.
Anales del Instituto de Física. — Universidad Nacional Autonoma de Mexico, Apartado Postal No. 31364, Mexico 20, D.F.

An. Mecan. Elect.
Anales de Mecanica y Electricidad. — Reina 31, Madrid.

An. Real Soc. Españ. Fís. Quím.
Anales de la Real Sociedad Española de Física y Química. Serie A - Física. Ciudad Universitaria, Madrid.

Analyt. Chem.
Analytical Chemistry. — American Chemical Society, 1155 Sixteenth Street N.W., Washington 6, D.C.

Angew. Chem.
Angewandte Chemie. — Verlag Chemie, Weinheim/Bergstr.17(a).

Ann. Acad. Sci. Fennicae
Annales Academiae Scientiarum Fennicae. Series A I: Mathematica-Physica. Series A II: Chemica. Series A III: Geologica-Geographica. — Snellmaninkatu 9-11, Helsinki.

Ann. Acfas
Annales de l'Acfas. — Association Canadienne Française pour l'Avancement des Sciences, Université de Montréal, 2900 Boulevard du Mont Royal, Montreal 26

Ann. Astrophys.
Annales d'Astrophysique. — Service des Publications du Centre National de la Recherche Scientifique, 13 Quai Anatole-France, Paris (VII^{e}).

Ann. Astrophys. Suppl.
Suppléments aux Annales d'Astrophysique. — Service des Publications du C.N.R.S.,13 Quai Anatole-France, Paris (VII^{e}).

Ann. Fac. Sci. Univ. Toulouse
Annales de la Faculté des Sciences de l'Université de Toulouse. — Published by: Gauthier-Villars, 55 Quai des Grands Augustins, Paris (VI^{e}).

Ann. Franç. Chronom.
Annales Françaises de Chronometrie. — Observatoire National de Besançon.

Ann. Geofis.
Annali di Geofisica. — Istituto Nazionale di Geofisica, Città Universitaria, Rome.

Ann. Geóphys.
Annales de Géophysique. — Service des Publications du C.N.R.S., 13 Quai Anatole France, Paris (VII^{e}).

Ann. Harvard Coll. Obs.
Annals of the Harvard College Observatory. — Cambridge, Massachusetts.

Ann. Inst. Fourier
Annales de l'Institut Fourier. — Grenoble.

Ann. Inst. Poincaré
Annales de l'Institut Henri Poincaré. — 11 Rue Pierre-Curie, Paris (V^{e}).

Ann. Phys. (Leipzig)
Annalen der Physik. — J.A.Barth, Salomonstrasse 18 B, Leipzig, C 1.

Ann. Phys. (Paris)
Annales de Physique. — Masson et Cie, 120 Boulevard Saint-Germain, Paris (VI^{e}).

Ann. Radioélect.
Annales de Radioélectricité. — 12 Rue Carducci, Paris (XIX^{e}).

Ann. sci. Ecole Normale Supér.
Annales Scientifiques de l'Ecole Normale Supérieure. — Published by: Gauthier-Villars, Quai des Grands-Augustins 55, Paris (VI^{e}).

Ann. Soc. Sci. Bruxelles
Annales de la Société Scientifique de Bruxelles. — 11 Rue des Recollets, Louvain.

Ann. Telécomm.
Annales de Télécommunication. — Centre National d'Etudes des Télécommunications, 24 Rue Bertrand, Paris (VII^{e}).

Ann. Tokyo Astron. Obs.
Annals of the Tokyo Astronomical Observatory. — University of Tokyo, Mitaka, Tokyo.

Ann. Univ. Turku
Annales Universitatis Turkuensis. Ser. A I: Astronomica-Chemica-Physica-Mathematica. — Turun Yliopiston, Turku, Finland.

Annu. Fac. Phil. Skopje. (Sect. Sci. nat.)
Annuaire de la Faculté de philosophie de l'Université de Skopje, Section des sciences naturelles. — Faculté de Philosophie, boite postale, 55, Skopje (Macedoine), Yougoslavie.

Annu. Proc. Assoc. Socs S.Africa
Annual Proceedings of the Associated Scientific and Technical Societies of South Africa. — Kelvin House, Marshall and Holland Streets, Johannesburg. (P.O.Box 5907).

Annu. Rep. Sci. Works Fac. Sci. Osaka Univ.
Annual Report of Scientific Works from the Faculty of Science, Osaka University. — Osaka University, Nakanoshima, Osaka, Japan.

Appl. Math. Ser. Nat. Bur. Stand.
Applied Mathematics Series, National Bureau of Standards. — U.S. Government Printing Office, Washington 25, D.C.

Appl. sci. Res.
Applied Scientific Research. Section A: Mechanics, Heat, Chemical Engineering, Mathematical Methods. Section B: Electrophysics, Acoustics, Optics, Mathematical Methods. — Martinus Nijhoff, The Hague.

Appl. Spectrosc.
Applied Spectroscopy. — Society for Applied Spectroscopy. Office of publication: 417 Cleveland Avenue, Plainfield, New Jersey, U.S.A.

Applic. and Industr.
Applications and Industry. — Part II of The Transactions of The American Institute of Electrical Engineers.

Arch. elekt. Übertragung
Archiv der elektrischen Übertragung. — S.Hirzel Verlag, Stuttgart.

Arch. Elektrotech. (Berlin)
Archiv für Elektrotechnik. — Springer-Verlag, Reichpietschufer 20, Berlin W.35; Neuenheimer Landstrasse 24, Heidelberg.

Arch. elektrotech. (Warsaw)
Archiwum Elektrotechniki. — Polska Akademia Nauk, 75 Koszykowa, Warsaw.

Arch. Math. Naturvid.
Archiv for Mathematik og Naturvidenskab. — Faculty of Mathematics and Science, University of Oslo, Blindern, per Oslo.

Arch. Sci. (Geneva)
Archives des Sciences. — Société de la Physique et d'Histoire Naturelle de Genève. Publication address: Librairie de l'Université, Georg et Cie, 5 Rue de la Corraterie, Geneva.

Arch. tech. Messen
Archiv für technisches Messen und industrielle Messtechnik. — R.Oldenbourg, Rosenheimer Str. 145, Munich 8.

Ark. Astron.
Arkiv för Astronomi. — Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist & Wiksell, Gamla Brogatan 26, Stockholm.

Ark. Fys.
Arkiv för Fysik. — Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist & Wiksell, Gamla Brogatan 26, Stockholm.

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Arkiv för Geofysik. — Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist & Wiksell, Gamla Brogatan 26, Stockholm.

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Arkiv för Kemi. — Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist & Wiksell, Gamla Brogatan 26, Stockholm.

Ark. Mat.
Arkiv för Matematik. — Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist & Wiksell, Gamla Brogatan 26, Stockholm.

Ark. Mineral.
Arkiv för Mineralogi och Geologi. -- Kungliga Svenska Vetenskapsakademien, Stockholm 50. Subscriptions to: Almqvist and Wiksell, Gamla Brogatan 26, Stockholm.

Asea J.
Asea Journal. — ASEA Electric Ltd., Fulbourne Road, London, E. 17; Allmänna Svenska Elektriska AB, Västerås.

Astron. J.
Astronomical Journal. — The American Astronomical Society. Publication address: Yale University Observatory, New Haven 11, Connecticut.

Astrophys. J.
Astrophysical Journal. — University of Chicago Press, Chicago.

Astrophys. Norveg.
Astrophysica Norvegica. — Faculty of Mathematics and Science, University of Oslo, Blindern, per Oslo.

Atom u. Strom
Atom und Strom. — [Issued as inset in Elektrizitätswirtschaft.] Bockenheimer Landstr. 109, Frankfurt am Main.

Atomic Energy Canada Rep.
Atomic Energy of Canada Ltd. Report. — Scientific Document Distribution Office, Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada.

Atomic Energy Res. Establ. (Harwell), Inf. Bibl.; Lecture; Mem.; Rep.; Transl.
Atomic Energy Research Establishment (Harwell), Information Bibliography; Lecture; Memoir; Report; Translation. — Her Majesty's Stationery Office, Kingsway, London, W.C.2.

Atomics (London)
Atomics and Nuclear Energy. — Leonard Hill Limited, Stratford House, 9 Eden Street, London, N.W.1.

Atomnaya energiya
Atomnaya energiya. — Akademiya Nauk SSSR, Cherkasskiĭ per., 2, Moscow. [English translations of selected papers, and English abstracts of the remaining papers, are published as Part II of The Journal of Nuclear Energy.]

Atti Accad. Sci. Torino
Atti dell' Accademia delle Scienze di Torino. — Via Accademia delle Scienze 6; Via Maria Vittoria 3, Turin (208).

Atti Fond. Ronchi
Atti della Fondazione Giorgio Ronchi e Contributi dell' Istituto Nazionale di Ottica. — Via S. Leonardo 79, Arcetri-Firenzi, Italy.

Atti Soc. Peloritana Sci. Fis. Mat. Nat.
Atti della Società Peloritana di Scienze Fisiche Matematiche e Naturali. — Università di Messina, Messina.

Austral. J. appl. Sci.
Australian Journal of Applied Science. — Commonwealth Scientific and Industrial Research Organization, 314 Albert Street, East Melbourne, C.2, Victoria.

Austral. J. Phys.
Australian Journal of Physics. — Commonwealth Scientific and Industrial Research Organization, 314 Albert Street, East Melbourne, C.2, Victoria.

Austral. J. Sci.
Australian Journal of Science. — The Australian and New Zealand Association for the Advancement of Science, Science House, 157 Gloucester Street, Sydney.

Automat. Elect. tech. J.
Automatic Electric Technical Journal. — 1033 West Van Buren Street, Chicago 7.

Avhandl. Norske VidensAkad. Oslo
Avhandlingar utgitt av Det Norske Videnskaps-Akademi i Oslo. I. Matematisk-Naturvidenskaplige Klasse. — Faculty of Mathematics and Science, University of Oslo, Blindern, per Oslo.

Avtomat. i Telemekh.
Avtomatika i Telemekhanika. — [Abstracted by The Electrical Research Association.]

B.B.C. Engng Monogr.
B.B.C. Engineering Division Monographs. — BBC Publications, 35 Marylebone High Street, London, W.1.

B.T.-H. Activ.
B.T.-H. Activities. — British Thomson-Houston Company, Rugby.

B.T.-H. Res. Lab. Publ.
British Thomson-Houston Research Laboratory Publication. — British Thomson-Houston Company, Rugby.

B.T.-H. tech. Monogr.
British Thomson-Houston Technical Monograph. — British Thomson-Houston Company, Rugby.

Beama J.
Beama Journal. — British Electrical and Allied Manufacturers' Association, 36 Kingsway, London, W.C.2.

Bell Lab. Record
Bell Laboratories Record. — Bell Telephone Laboratories, 463 West Street, New York 14, N.Y.

Bell Syst. tech. J.
Bell System Technical Journal. — American Telephone and Telegraph Co., 195 Broadway, New York 7, N.Y.

Ber. Dtsch. Keram. Gesell.
Berichte der Deutschen Keramischen Gesellschaft. — [Article reprinted in Entwicklungsber. Siemens und Halske.]

Bol. Fac. Ingen. Montevideo
Boletin de la Facultad de Ingenieria y Agrimensura de Montevideo. — Herrera y Reissig 565, Montevideo.

Brennstoff-Wärme-Kraft (B.W.K.)
BWK. Brennstoff-Wärme-Kraft. — Deutscher Ingenieur-Verlag, Prinz-Georg-Strasse 77, Düsseldorf.

Brit. Commun. and Electronics
British Communications and Electronics. — Heywood and Co., Drury House, Russell Street, London, W.C.2.

Brit. J. appl. Phys.
British Journal of Applied Physics. — Institute of Physics, 47 Belgrave Square, London, S.W.1.

Brit. J. Radiol.
British Journal of Radiology. — British Institute of Radiology, 32 Welbeck Street, London, W.1.

Brit. Stand.
British Standards. — British Standards Institution, 2, Park Street, London, W.1.

Brit. Weld. J.
British Welding Journal. — Institute of Welding, 2 Buckingham Palace Gardens, London, S.W.1; British Welding Research Association, 29 Park Crescent, London, W.1.

Brown Boveri Rev.
Brown Boveri Review. — Brown Boveri and Company, Baden, Switzerland; 75 Victoria Street, London, S.W.1.

Bul. Inst. Politeh. Iaşi
Buletinul Institutului Politehnic din Iasi. Serie Nouă. — Mathematical Institute, Polytechnical Institute, Jassy.

Bull. Acad. Polon. Sci.
Bulletin de L'Académie Polonaise des Sciences, Classe Troisième: Mathématique, Astronomie, Physique, Chimie, Géologie et Géographie; Classe Quatrième: Mécanique appliquée, Electrotechnique, Science des Mines, Métallurgie, Construction Mécanique, Génie Civil, Architecture. — Polska Akademie Nauk. Publication address: Prasa i Ksiażka, al. Foksal 18, Warsaw 10.

Bull. Acad. Roy. Belgique Cl. Sci.
Bulletin de la Classe des Sciences de l'Académie Royale de Belgique. — Palais des Académies, rue Ducale 1, Brussels.

Bull. Amer. Meteorol. Soc.
Bulletin of the American Meteorological Society. — 3 Joy St., Boston 8, Massachusetts.

Bull. Assoc. Suisse Elect.
Bulletin de l'Association Suisse des Electriciens. — [Organe commun de l'Association Suisse des Electriciens (ASE) et de l'Union des Centrales Suisse d'Electricité (UCS)]. Seefeldstrasse 301, Zürich 8.

Bull. astron. (Paris)
Bulletin Astronomique. — L'Observatoire de Paris, 61 Avenue de l'Observatoire, Paris (XIV^{e}). Published by: Gauthier-Villars, Quai des Grands Augustins 55, Paris (VI^{e}).

Bull. Calcutta Math. Soc.
Bulletin of the Calcutta Mathematical Society. — 92 Upper Circular Road, Calcutta 9.

Bull. Cent. Phys. Nucléaire Bruxelles
Bulletin du Centre de Physique Nucléaire de l'Université Libre de Bruxelles. — 50 Avenue F.D.Roosevelt, Brussels.

Bull. elect. Engng Educ.
Bulletin of Electrical Engineering Education. — Manchester College of Science and Technology, Manchester 1.

Bull. Electrotech. Lab. (Tokyo)
Bulletin of the Electrotechnical Laboratory. — Agency of

Industrial Science and Technology, Ministry of International Trade and Industry, 2-chome, Nagato-cho, Chiyoda-ku, Tokyo.

Bull. Engng Res. Inst. Kyoto Univ.
Bulletin of the Engineering Research Institute of Kyoto University. — Kyoto.

Bull. Fac. Engng Yokohama Nat. Univ.
Bulletin of the Faculty of Engineering of Yokohama National University. — Faculty of Engineering, Yokohama National University, Yokohama.

Bull. Inst. Internat. Froid.
Bulletin de l'Institut International du Froid (French/English Edition). — [Formerly issued in two editions (English and French) and referenced as: Bull. Internat. Inst. Refrig.] 177 Boulevard Malesherbes, Paris (XVII^{e}).

Bull. Inst. Metals
Bulletin of the Institute of Metals. — [Issued as inset in Journal of the Institute of Metals.] 17 Belgrave Square, London, S.W.1.

Bull. Inst. Nuclear Sci. "Boris Kidrich"
Bulletin of the Institute of Nuclear Sciences "Boris Kidrich".— Institute of Nuclear Sciences "Boris Kidrich", P.O.Box 522, Belgrade.

Bull. Internat. Inst. Refrig.
Bulletin of the International Institute of Refrigeration. — Now Bulletin de l'Institut International du Froid (French/English Edition) [Bull. Inst. Internat. Froid].

Bull. Internat. Rly Congr. Assoc.
Monthly Bulletin of the International Railway Congress Association [English edition]. — 19 rue du Beau-Site, Brussels.

Bull. Oerlikon
Bulletin Oerlikon. — Ateliers de Constructions Oerlikon, Zürich 50; Oerlikon Ltd., Victoria House, Southampton Row, London, W.C.1.

Bull. Res. Coun. Israel
Bulletin of the Research Council of Israel. Section A, Mathematical and Physical Sciences; Section B, Biological and Earth Sciences; Section C, Applied Science and Technology. — The Israel Scientific Press, 33 King George Avenue, Jerusalem.

Bull. Sci. Assoc. Ingén. Montefiore [A.I.M.]
Bulletin Scientifique de l'Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore.— 31 Rue Saint Gilles, Liège.

Bull. sci. Cons. Acad. Yougoslavie
Bulletin Scientifique, Conseil des Académies de la R.P.F. Yougoslavie. — Kukovicéva b.p. 436, Zagreb 1.

Bull. Soc. Belge Elect.
Bulletin de la Société Belge des Electriciens. — 1 Place du Trône, Brussels.

Bull. Soc. Chim. France
Bulletin de la Société Chimique de France. — Published by: Masson et Cie, 120 Boulevard Saint-Germain, Paris (VI^{e}).

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Bulletin de la Société Française des Electriciens. — 8-14 Avenue Pierre Larousse, Malakoff (Seine). Published by: Gauthier-Villars, 55 Quai des Grands Augustins, Paris (VI^{e}).

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Technische Mitteilungen PTT. (Bulletin Technique PTT). — Schweizerische Post-, Telegraphen- und Telephonverwaltung, Speichergasse 6, Bern.

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ABSTRACTING JOURNALS

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American Society of Mechanical Engineers, 29 West 39th St., New York 18: Editorial Office: Southwest Research Institute, 8500 Culebra Road, San Antonio 6, Texas.

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Bulletin of the British Society of Rheology. — Editor: E.W.J.Mardles, Esq., Exonia, Cedar Road, Farnborough, Hants.

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Bulletin de l'Institut International du Froid. — 177 Boulevard Malesherbes, Paris (XV^{e}).

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Mathematical Tables and Other Aids to Computation. — National Academy of Sciences, 2101 Constitution Avenue, Washington, D.C.

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Metropolitan-Vickers Technical News Bulletin. — Research Department, Metropolitan-Vickers Electrical Co., Trafford Park, Manchester.

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Technical Information Service, U.S. Atomic Energy Commission, P.O.Box 62, Oak Ridge, Tennessee.

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Royal Photographic Society of Great Britain, 16 Princes Gate, London, S.W.7.

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Centralny Instytut Dokumentacji Naukowo-Technicnej, Warsaw 12.

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Institution of Civil Engineers, Great George Street, London, S.W.1.

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Bulletin of the British Scientific Instrument Research Association. — Information Department, "Sira", Southill, Elmstead Woods, Chislehurst, Kent.

PHYSICS ABSTRACTS

Volume 60 JUNE 1957 Number 714

MATHEMATICS 51

512.942

4958. VECTOR RESULTANTS OBTAINED GRAPHICALLY THROUGH CENTROIDS. S.I.Askovitz.
Amer. J. Phys., Vol. 25, No. 4, 254-6 (April, 1957).

A simple method is presented whereby the resultant of a set of vectors in a plane may be determined or checked, by locating the centroid of the starting points of the vectors and the centroid of their end-points. A.

517.5

4959. CHARACTERIZATION OF SPECTRA BY MEANS OF INDICATIVE FUNCTIONS [FONCTIONS INDICATRICES]. F.Aeschlimann.
J. Phys. Radium, Vol. 17, No. 11, 950-5 (Nov., 1956). In French.

The notion of indicative function introduced by Destouches (Abstr. 2569/1957) is used to characterize some common spectra, particularly those connected with the sine and Γ-function. The relation between indicative functions of spectra of quantities one a function of the other, is discussed. The spectrum connected with the Bessel function $J_{1/3}$ is treated as an example. Finally the notion is extended to radioactive systems with quasi-stationary levels. L.Pincherle

517.6 : 530.162

4960. INTEGRALS OVER THE FERMI FUNCTION. R.Blankenbecler.
Amer. J. Phys., Vol. 25, No. 5, 279-80 (May, 1957).

A formal device for evaluating integrals over the Fermi distribution function is presented. An expansion of the formal solution yields Sommerfeld's familiar result obtained in connection with the electron theory of metals. In special cases, the result can be expressed in closed form. One such case, the scattering form-factor for the Fermi distribution, is presented. Application of the method to other integrals is indicated. A.

517.6 : 530.145

4961. EVALUATION OF CONFIGURATION INTEGRALS FOR A SYSTEM OF PARTICLES WITH COULOMB INTERACTION. D.N.Zubarev.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 4, 757-60 (1954). In Russian.

The Coulomb interaction between the i-th particle and the j-th particle is summed over all values of i and j and integrated over all phase space. In particular practical cases (e.g. electrolytes, ionized gases, electron gas in compensating field) evaluation is facilitated by replacing certain integrals by equivalent linear operators. J.W.Gardner

518.1

4962. INTRODUCTION TO A THEORY OF SETS BASED ON PRIME NUMBERS, ADAPTABLE TO ELECTRONIC COMPUTER PROGRAMMING. S.Sabliet.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 35-8 (Jan. 2, 1957). In French.

In this method each function (trigonometric, logarithmic, differential, etc.,) is coded by allotting it a prime number. Functions of functions are then represented by products of prime numbers, and this product is therefore unique, and unobtainable in any other way. The principle is demonstrated by a brief example, and the general possibilities of the system are discussed in relation to the memory capacity of practical computers. A.J.Kennedy

518.4

4963. OPTIMUM LINEAR-SEGMENT FUNCTION GENERATION. H.Hamer.
Trans Amer. Inst. Elect. Engrs I, Vol. 75, 518-20 (1956) = Commun. and Electronics, No. 27 (Nov., 1956).

Describes an analytical method for determining the smallest error obtainable, and the break points and slopes which will achieve the optimum approximation. "Optimum" is defined in the sense that the maximum error between the given function and the approximating curve is as small as possible for the given function and a given number of segments. The method assumes perfect straight line segments. K.C.Garner

518.5 : 551.594.14

4964. A HIGH-SPEED COMPUTER FOR PREDICTING RADIOACTIVE FALLOUT. J.H.Wright, L.Taback and H.K.Skramstad.
J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 101-9 (Feb., 1957).

A very high-speed analogue computer has been developed for predicting the geographic pattern of radioactive fallout that will occur following a nuclear-weapon explosion. Input data consist of wind magnitudes and directions as functions of initial height in the cloud, and the distribution of radioactivity in the cloud as a function of the particle size (in terms of settling rate) and initial height in the cloud. Output data are presented on a cathode-ray tube, so that the luminance at any point on the screen represents the intensity of fallout accumulated at that point. A.

519.2 : 621.391

4965. ON THE CAPACITY OF A DISCRETE CHANNEL. II. MATHEMATICAL EXPRESSION OF THE CAPACITY OF A NOISY CHANNEL WHICH IS EXPRESSIBLE BY CORRESPONDING TWO MULTI-STATE DIAGRAMS. S.Muroga.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1109-20 (Oct., 1956).

For Pt I see Abstr. 8182 (1953). After explaining the use of Shannon's diagram to describe a Markoff process, a noisy channel of a general character in which the transmitter has constraints on allowed sequences of symbols and is disturbed by a Markoff noise is described by correlating two multi-state diagrams which correspond to the transmitter and the receiver, respectively. The set of probabilities of transitions from a symbol in the transmitting diagram to one in the receiving diagram specifies the stochastic character of transmission. Then a mathematical expression for the transmission rate is deduced. Finally, the problem of finding the channel capacity as the maximum of the transmission rate is discussed with some numerical examples. A.

519.21 : 537.542

4966. ENERGY SPECTRUM OF CERTAIN RANDOM FUNCTIONS OF THE FORM ±1. G.Mabboux-Tariel and C.Mabboux.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1509-11 (Nov. 12, 1956). In French.

The function V(t) is defined to take on successively the values +1 and −1, the time interval between successive jumps being determined by a probability distribution. The correlation $E\{V(t)V(t+\tau)\}$ is expressed as a Fourier integral, and an expression is derived for the spectral density. The theory is applied to a modified Poisson distribution for which there exists a constant dead time τ_0 after each jump. Application to the theory of particle counters is indicated. R.A.Newing

519.24 : 620.11

4967. SELECTING THE BEST ONE OF SEVERAL BINOMIAL POPULATIONS. M.Sobel and M.J.Huyett.
Bell Syst. tech. J., Vol. 36, No. 2, 537-76 (March, 1957).

Tables have been prepared for use in any experiment designed to select that particular one of k binomial processes or populations with the highest (long time) yield or the highest probability of success. Before experimentation the experimenter chooses two constants d* and P* ($0 < d^* \leq 1$; $0 \leq P^* < 1$) and specifies that he would like to guarantee a probability of at least P* of a correct selection whenever the true difference between the longtime yields associated with the best and the second best processes is at least d*. The tables show the smallest number of units required per process to be put on test to satisfy this specification. Separate tables are given for k = 2, 3, 4 and 10. Each table gives the result for d* = 0.05 (0.05) 0.50 and for P* = 0.50, 0.60, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95 and 0.99. For values of d* and P* not considered in the

tables, graphs are given on which interpolation can be carried out. Graphs have also been constructed to make possible an interpolation for other values of k. An alternative specification is given for use when the experimenter has some a priori knowledge of the processes and their probabilities of success. This specification is then compared with the original specification. Applications of these tables to different types of problems are considered. A.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.2 : 535.833

4968. THE DOUBLING OF TELESCOPIC IMAGES. J.Rösch.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2020-3 (Dec. 17, 1956). In French.

By recourse to geometrical optics it is shown how, in certain specified conditions e.g. in high-contrast photography of the solar disk, some details will appear to be duplicated. Also, the possibility of triplicated images cannot be ruled out, and one such set has actually been observed. D.R.Barber

522.2

4969. MODERN DEVELOPMENTS IN TELESCOPE OPTICS. E.H.Linfoot.
"Vistas in Astronomy", Volume I, 351-71. See Abstr. 10 (1957).

Gives a brief account of the development of the Schmidt and Schmidt-Cassegrain systems. New developments in their application to the problem of aberration balancing in fast Schmidt cameras are described. A.Beer

522.61

4970. ASTRONOMICAL SPECTROGRAPHS: PAST, PRESENT, AND FUTURE. I.S.Bowen.
"Vistas in Astronomy", Volume I, 400-405. See Abstr. 10 (1957).

Recent optical advances are outlined which have made possible the use of apertures and focal ratios of a different order than those hitherto available. A reassessment of spectrograph designs is made, and the relevant equations derived. The author's design of the Coudé spectrograph for the 200 in. Mount Palomar telescope is elaborated. Finally, two possible ways for still further increasing efficiency are indicated. One is a scheme similar to the image slicer, which changes the shape of the star image to a long narrow one. The other procedure points to an improvement in grating ruling techniques; various solutions (e.g. making a "Venetian blind" grating) are suggested in detail. A.Beer

522.612

4971. AN F/2 CASSEGRAIN CAMERA. A.B.Meinel.
Astrophys. J., Vol. 124, No. 3, 652-4 (Nov., 1956).

A Cassegrain camera system to provide prime-focus performance at the Cassegrain focus has been constructed. Utilization of this camera with the 82 in. McDonald telescope and the 40 in. Yerkes refractor would indicate that this camera system could be used with advantage on many existing telescopes. A.

522.612

4972. A FRINGE PHOTOMETER FOR THE MEASUREMENT OF DIFFERENT REGIONS OF AN OBJECT OBSERVED THROUGH A TELESCOPE. A.Dollfus.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1833-5 (Dec. 5, 1956). In French.

The principle of Savart's polariscope is applied to a double-image eyepiece photometer in which disappearance of the fringe system is used as the criterion of equality of the telescopic field under examination with that of an artificial comparison field. The instrument measures the integrated magnitude of a planet, and may also be used for precision measures in the laboratory. D.R.Barber

522.612

4973. A DOUBLE-IMAGE PHOTOMETER FOR COMPARING SPOTS ON THE SURFACE OF A PLANET. A.Dollfus.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2023-6 (Dec. 17, 1956). In French.

The instrument described in the preceding abstract allows of a direct visual comparison being made of different small regions of a planetary surface. D.R.Barber

522.615

4974. AN ASTRONOMICAL PHOTOELECTRIC SPECTROPHOTOMETER. J.E.Geake and W.L.Wilcock.
Monthly Not. Roy. Astron. Soc., Vol. 116, No. 5, 561-9 (1956).

An instrument is described for the direct recording of astronomical spectral profiles. It consists of a prism monochromator whose output is recorded photoelectrically as the wavelength transmitted is varied. Compensation for atmospheric seeing effects is essential when narrow slits are used, and is provided by recording, as the compensated profile, the ratio of the monochromator output to the undispersed light collected after the entrance slit. The performance of this compensation, and the limiting effects of shot noise on the accuracy of the instrument, are discussed. The instrument has been used with a fairly high resolution (about 0.6 A) to record stellar absorption line profiles, and with a low resolution, as a slitless spectrograph, to measure the relative intensities of emission lines of planetary nebulae. A.

523.03

4975. A SYSTEM OF QUANTITATIVE ASTRONOMICAL OBSERVATIONS. C.W.Allen.
"Vistas in Astronomy", Volume I, 149-55. See Abstr. 10 (1957).

A classification is developed of the various methods and devices available for detecting and measuring the stellar electromagnetic radiations, visible or invisible. The requirements and a system of 25 fundamentally different types of measurements are discussed, and a new approach is indicated; the need for as many as possible "primary" measurements is stressed. A.Beer

523.03

4976. FACT AND INFERENCE IN THEORY AND OBSERVATION. H.Bondi.
"Vistas in Astronomy", Volume I, 155-62. See Abstr. 10 (1957).

A critical examination is made of the relative reliabilities in theoretical and observational work in astronomy. It is found that, contrary to widely held opinions, observational papers are no less liable than theoretical papers to reach erroneous conclusions. A.Beer

523.03

4977. ATOMIC COLLISION PROCESSES IN ASTROPHYSICS. H.S.W.Massey.
"Vistas in Astronomy", Volume I, 277-83. See Abstr. 10 (1957).

Although the majority of the applications of atomic physics to astrophysics have been concerned with various radiative processes, there are important cases in which a knowledge of the rates of collision processes involving electrons, ions and/or neutral atoms and molecules is required (e.g. theory of the solar corona, chromospheric emission, auroral and nebular lines). Progress has been made in the theory of ineleastic collisions of electrons with atoms. Recent work on collisions involving atomic systems is discussed. A.Bee

523.112

4978. THE PHYSICS OF THE EXPANDING UNIVERSE. G.Gamow.
"Vistas in Astronomy", Volume II, 1726-32. See Abstr. 10 (1957).

After discussing current hypotheses aiming at the interpretation of the observed red-shift of spectral lines, indications are emphasized of the presence of evolutionary trends in the Universe at large. In its three main sections the paper deals with the importance of thermal radiation in cosmology, with the "radiation era" and "matte era" in the history of the Universe, and with the formation of chemical elements and the origin of the galaxies. Extensive numerical and graphical representations are provided. A.Beer

523.1

4979. THE GRAVITATIONAL INSTABILITY OF AN INFINITE HOMOGENEOUS MEDIUM WHEN A CORIOLIS ACCELERATION IS ACTING. S.Chandrasekhar.
"Vistas in Astronomy", Volume I, 344-7. See Abstr. 10 (1957).

It is shown that Jeans's criterion for the gravitational instability of an infinite homogeneous medium remains unaffected even if the system is partaking in rotation and Coriolis forces are acting. The importance of the criterion in modern cosmogony is stressed: it enables one to estimate the scale of the condensations which may take place in an extended gaseous medium. And the possibility of

estimating this will give precision to the ideas one may have regarding the formation of stars and of galaxies from an "original primeval nebula". Reference is made to two recent applications of this concept by Spitzer and by Gamow. A.Beer

523.162

4980. INTERSTELLAR ABSORPTION LINES IN DISTANT STARS. I. NORTHERN MILKY WAY. G.Münch.
Astrophys. J., Vol. 125, No. 1, 42-65 (Jan., 1957).

Measures of radial velocities and intensities of the Ca II and/or Na I interstellar lines are given for 112 stars near the galactic plane and with longitudes between 55° and 160°. In stars at distances not smaller than about 2 kiloparsecs two strong components are observed, with relative separations depending on galactic longitude and reaching a maximum of about 30 km/sec around $l = 100°$. It is shown that this separation is an effect of galactic rotation, and it is inferred that the interstellar gas clouds producing the observed lines are arranged in space along the spiral arms outlined by the space distribution of H II regions. The connection between data derived from the optical absorption lines and other indicators of spiral structure, such as the space distributions of O associations and interstellar hydrogen, is discussed. It is found that the interstellar gas around distant O associations has systematic expanding motions, revealed by line components shifted to the violet with respect to the velocities of the associations by amounts of the order of 20 km/sec. The mean intensity-ratio-curves of the Na I and Ca II doublets in nearby stars are rediscussed. It is shown that they may be accounted for by a velocity distribution of the interstellar clouds exponential in form and with mean speed η constant within a spiral arm rather than by a Gaussian distribution with dispersion increasing with distance from the observer. An indication has been found that the η(Na I) for the lines formed in the Perseus arm is larger by factors between 1.2 and 1.5 than for the lines formed in the Orion arm. The existence of variations in shape of the velocity distribution of the interstellar clouds, in relation to the geometry of the spiral arms, is suggested. A.

523.164.32

4981. SYNCHROTRON RADIATION IN THE SUN'S RADIO SPECTRUM. U.E.Kruse, L.Marshall and J.R.Platt.
Astrophys. J., Vol. 124, No. 3, 601-4 (Nov., 1956).

It is suggested that synchrotron radiation by non-relativistic electrons in sunspots makes an important contribution to the sun's radio spectrum. In particular, those outbursts displaying simultaneous emission of two radiofrequency components, one at twice the frequency of the other, can be explained by the properties of synchrotron radiation from electrons moving in large magnetic fields. Assuming this mechanism, it is found that the velocity of the emitting electrons relative to the velocity of light lies between the limits $0.002 \leq \beta \leq 0.2$ A.

523.164.4

4982. A SURVEY OF COSMIC RADIO EMISSION AT 600 Mc/s. J.H.Piddington and G.H.Trent.
Austral. J. Phys., Vol. 9, No. 4, 481-93 (Dec., 1956).

The results are given of a survey of cosmic radio emission at 600 Mc/s between declinations 90°S. and 51°N. using a 3°.3 wide beam. Isophotes are plotted in a system of celestial coordinates (epoch 1955). The determination of radio spectra from surveys at different frequencies is discussed. A vital factor which tends to be neglected is the allowance made for side and back aerial lobes; a method of making such allowance is suggested. The possible sources of the emission are discussed. Away from the galactic plane the radiation is non-thermal. On the galactic plane and near the galactic centre the evidence, while not conclusive, suggests a mainly thermal origin. The radio isophotes are used to determine a galactic pole. In Lund coordinates this is at $l \sim 330°$, $b = 89°.1$ with the Sun at a distance of about 50 parsees north of the galactic plane. A.

523.164.42

4983. THE SOURCES OF RADIO EMISSION IN NGC 5128 AND NGC 1316. G.R.Burbidge and E.M.Burbidge.
Astrophys. J., Vol. 125, No. 1, 1-8 (Jan., 1957).

Bolton has pointed out that both NGC 5128 and NGC 1316 are fairly similar radio sources which have two distributions of radio emission — a central region, with roughly the dimensions of the optical galaxy, and a halo of much greater extent. On the assumption that the emission is synchrotron radiation of electrons and positrons moving in magnetic fields, the possible range of total particle and magnetic-field energies are calculated. If electrons and positrons form the major part of the total particle flux, the minimum values of total energy and effective magnetic field strengths are $\sim 10^{55}$ ergs and $\sim 10^{-5}$ gauss in the central regions and $\sim 10^{57}$ ergs and $\sim 10^{-6}$ gauss in the halo regions. If the electron-positron flux is derived from a proton flux of larger total energy, the minimum values are $\sim 10^{57}$ ergs and $\sim 2 \times 10^{-4}$ gauss in the central regions and $\sim 10^{59}$ ergs and $\sim 10^{-5}$ gauss in the halos. Possible theories of the origin of the particle flux, including the annihilation of antiprotons by protons, and interpretations of the nature of the galaxies are discussed. A.

523.164.42

4984. AN INVESTIGATION OF THE RADIO SOURCE 06N2A IN GEMINI. H.Rishbeth.
Austral. J. Phys., Vol. 9, No. 4, 494-504 (Dec., 1956).

A lunar occultation of the radio source 06N2A in Gemini was observed in the course of an investigation at a wavelength of 3.5 m, for which the "Mills Cross" aerial was employed. During the occultation the intensity of the source was reduced by over one-fifth, although less than one-tenth of the associated galactic nebulosity IC 443 was obscured. The radio source appears to resemble the nebula, and the relation between them is discussed with the aid of simple geometrical models of the source. A comparison of the intensity of the source with previously published values shows that the emission at metre wavelengths is mainly non-thermal. A.

523.164.42

4985. MEASUREMENTS OF THE ANGULAR DIAMETERS OF TWO GALACTIC RADIO SOURCES AT A WAVELENGTH OF 10.7 cm. B.Rowson.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 328-30 (March, 1957).

Describes apparatus used and preliminary results obtained for Cassiopeia and Taurus. The results are plotted and compared with the corresponding metre-wave results, (Abstr. 1337/1953, 10737/1954, 1799-800/1956). There is no significant difference in the diameter of the Taurus source. For the Cassiopeia source, the metre-wave results are systematically lower than the 10 cm results. If the difference is real, the Cassiopeia source may be 10 or 20% smaller at the higher frequency. J.J.Phipps

523.164.85

4986. RADIO ECHO OBSERVATIONS OF METEOR ACTIVITY IN THE SOUTHERN HEMISPHERE. C.D.Ellyett and C.S.L.Keay.
Austral. J. Phys., Vol. 9, No. 4, 471-80 (Dec., 1956).

A further analysis has been made of 32 000 meteor echoes obtained during 1953 by radar apparatus operating at a frequency of 69 Mc/s. Monthly and annual mean diurnal rate curves have been drawn, revealing a strong similarity between southern and northern hemisphere results. It is concluded that most meteoric matter incident on the southern hemisphere, down to magnitude + 4.5, is confined to direct orbits closely following the plane of the ecliptic. Subsequently the sensitivity of the equipment was increased to yield echo rates much higher than the equivalent visual rates. Analysis of the results obtained during February and March 1956, which are normally regarded as being months devoid of showers, reveals discrete radiant activity near the helion and antihelion positions. This result largely removes the former distinction between shower and sporadic meteors, since many of the meteors previously regarded as sporadic represent the upper limit of showers of minor-sized particles. A.

523.5.03

4987. INADEQUACY OF RECOMBINATION AS SOURCE OF RADIATION FROM METEORIC TRAINS. A.F.Cook and G.S.Hawkins.
Astrophys. J., Vol. 124, No. 3, 605-9 (Nov., 1956).

The assumption is made that recombination of ions and free electrons produces the observed luminosity in meteoric trains. Available theoretical and observational results are used to establish an upper limit on the intensity of radiation from this source. This limit is compared with the threshold intensity at the observed epoch of disappearance of the train. Recombination is shown to fail, by at least two or three orders of magnitude, to account for the observed intensity. A.

523.51 : 534.222.2

4988. THE IMPACT OF LARGE METEORITES. J.J.Gilvarry and J.E.Hill.
Astrophys. J., Vol. 124, No. 3, 610-22 (Nov., 1956).

The impact of large meteorites on the moon or earth is discussed on the basis of a one-dimensional idealization of the flow problem, in which a plane shock-wave is considered in both meteorite and impact surface. Conditions are discussed under which such a model can yield physically valid estimates of pressure and temperature generated on explosive impact of meteorites. Computations are carried out for an equation of state and internal energy from the statistical Thomas–Fermi atom model; departures from complete

degeneracy are taken into account by means of results of a first-order perturbation with respect to temperature. It is assumed that the meteorite and impact surface are composed of the same pure element, taken as silicon, iron, and an average element (in a sense defined) for meteorites. The range of impact velocity considered goes up to the limit possible for meteorite origin in the solar system, which is well in excess of Whipple's estimates of mean atmospheric velocity for meteorite falls. Over this range, values of compression ratio, pressure, and temperature behind the shocks and of shock velocities are exhibited as functions of impact velocity; at the lowest and the highest velocities, results are only qualitative. Shock temperatures computed for iron agree reasonably with extrapolation of experimental data of Walsh and Christian for copper at lower pressures. The results yield pressures and temperatures of explosive magnitude behind the shock waves, in confirmation of the views of Gifford and Baldwin. Computed fusion temperatures behind the shocks show no inconsistency with Urey's mechanism of formation of lunar maria. A.

523.51 : 523.12

4989. DIAMONDS, METEORITES, AND THE ORIGIN OF THE SOLAR SYSTEM. H.C.Urey.
Astrophys. J., Vol. 124, No. 3, 623-37 (Nov., 1956).

In order to explain the chemical composition and physical structures of meteorites, it is proposed that two sets of objects of asteroidal and lunar size were accumulated and destroyed during the history of the solar system. These are referred to as the "primary" and "secondary" objects. Since diamonds occur in meteorites, some of the objects must have been of lunar mass or greater; but it is not possible to be certain as to whether this occurred in the primary or secondary objects. The ages of the meteorites require that the primary objects accumulated about 4.5×10^9 years ago, were heated by some means to the melting point of silicates and iron, were then cooled to $\sim 500^\circ$C for 10^7-10^8 years, and subsequent to this were broken into fragments of less than centimeter and millimeter sizes. The secondary objects accumulated from these about 4.3×10^9 years ago, and they were at least of asteroidal size. These objects were broken up at some time or times during the last 4.5×10^9 years, and the fragments are the meteorites. These collisional processes occurred during the formation of the solar system. The primary objects must have antedated the time of active formation of the system. Solid objects appeared early during the formation of the system and played an important physical role during the formation of the planetary system and possibly in the formation of the sun. It is suggested that the solar nebula consisted of a disk of gas and solid objects and that the dissipation of the gases and some of the solids took place from this disk. Protoplanets in the sense of large masses of gas and dust of solar composition did not occur, at least in the case of the terrestrial planets, and not until much dissipation of the gases and dust had occurred. A.

523.51 : 539.152.2

4990. ON THE ORIGIN OF THE INERT GASES IN STONY METEORITES. É.K.Gerling and L.K.Levskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 750-3 (1956). In Russian.

A study of the isotopic composition of inert gases in stony meteorites. That of A, Ne, and He is given in a table for several meteorites. The age of the meteorite (from A^{40}) and the abundance ratios, e.g. A^{40}/A^{36}, are also given together with data previously obtained. The rate of accumulation of the inert gases from various causes is calculated and given in a second table. A special study of the achondrite Staroe Pes'yanoe indicates that some isotopes of Ne and A in it must have been captured from the atmosphere of the parent body at the moment of solidification. On this assumption the partial pressures of He, Ne, and A in this atmosphere are calculated, assuming that the solubility of the inert gases at 1500-2000°C is not very different from that of He.

	He	Ne	A
Partial pressure in mm	≥ 2200	~ 9	~ 0.7

Only a body of planetary dimensions could maintain such a large pressure of He. G.A.Chisnall

523.59

4991. THE ZODIACAL LIGHT. H.C.van de Hulst.
"Vistas in Astronomy", Volume II, 998-1001. See Abstr. 10 (1957).

The advance made through the recognition (besides the polarization of the dust component) of a component of the zodiacal light as due to scattering by free electrons in interplanetary space is characterized, and the formula derived which leads to the electron density. The numerical result is 610 electrons per cm^3 somewhat inside the earth's orbit; the actual value is estimated to be within 0.5 and 1.5 of this figure. The electron density appears to be proportional to $r^{-1.5}$ or $r^{-1.7}$, where r is the distance from the sun. The problem of the "gegenschein" is also dealt with; it is found that this requires another factor 10 in observational precision for its solution. A.Beer

523.67 : 539.132

4992. ANALYSIS OF NH_2 BANDS OBSERVED IN THE VISIBLE REGION OF THE AMMONIA SPECTRUM, FROM THE STUDY OF COMETARY SPECTRA. P.Proisy.
C.R. Acad. Sci.(Paris), Vol. 243, No. 18, 1305-7 (Oct. 29, 1956). In French.

Two band systems of NH_2 lying between 4719 and 6300 A which have been previously classified as those which are and those which are not observed respectively in cometary spectra (Abstr. 7273/1956), have been re-examined in comparison with cometary spectra. It is suggested that the electronic transitions involved are respectively $^2A_1$-$^2B_1$, $^2B_2$-$^2A_1$. R.W.Nicholls

523.72

4993. TEMPERATURE AT THE POLES AND AT THE EQUATOR OF THE SUN. A.K.Das and K.D.Abhyankar.
"Vistas in Astronomy", Volume I, 658-66. See Abstr. 10 (1957).

The equivalent widths of the g- and the K-lines of the sun are measured at the solar equator and at the pole during a minimum of solar activity. The resulting difference of temperature is evaluated by Woolley's method of the calcium ionization temperature. The pole is found to be hotter by 96° or 86° (depending on the choice of the continuous absorption coefficients). This result supports Bjerknes's thermohydrodynamical theory of sunspots. Its further application leads to a value of 125 or 140 km for the depth of the sunspot umbral column. A.Beer

523.746

4994. THE STRUCTURE OF SUNSPOTS. P.A.Sweet.
"Vistas in Astronomy", Volume I, 675-85. See Abstr. 10 (1957).

The observational data of sunspots are used to construct a model of the surface layers. A theoretical interpretation of this leads to a theory of the origin of the Evershed effect. The deeper layers are discussed and an appreciation is given of current theories of the origin of the darkening. The origin of the magnetic field and the relation of sunspots to the solar cycle are not considered. A.Beer

523.752

4995. LYMAN-α AND THE STRUCTURE OF THE SOLAR CHROMOSPHERE. R.G.Athay and R.N.Thomas.
Astrophys. J., Vol. 124, No. 3, 586-96 (Nov., 1956).

Investigates the range of chromospheric models compatible with present rocket observations of Lyman-α and concludes that it is considerable. It would require detailed observations of the line profile, with resolution better than one Doppler half-width, to be more specific on the actual model. A considerable difference is found between T_e and a radiation temperature defined by the line intensity, in conformity with earlier discussions of the non-equilibrium chromosphere by the authors and by Giovanelli. A discussion of the relation of these results to the limb flare and S.I.D. correlations found by Warwick suggests a more extended investigation of the non-spherically symmetric model and its relation to the chromospheric opacity in Lyman-α. A.

523.752

4996. MOTIONS OF PROMINENCES. M.Correll, M.Hazen and J.Bahng.
Astrophys. J., Vol. 124, No. 3, 597-600 (Nov., 1956).

The trajectories of luminous materials in active-region prominences frequently display patterns which are suggestive of the line-of-force configurations around a magnetic dipole. An attempt was made to fit an idealized field to an actual prominence, and a reasonably good correspondence between lines and trajectories was obtained. The results suggest that the dipole in this case is located at 0.2 solar radius beneath the surface of the sun. A.

523.752 : 550.385

4997. INTERVAL OF TIME BETWEEN CHROMOSPHERIC ERUPTIONS AND GEOMAGNETIC PERTUBATIONS. O.Sipahioglu.
C.R. Acad.Sci. (Paris), Vol. 243, No. 19 , 1427-30 (Nov. 5, 1956). In French.

To obtain a more precise determination of the time of the event the procedure of superposed epochs has been used. Data are obtained for the solar flare effects (S.F.E.), sudden storm commencements (S.S.C.) and sudden impulses (S.I.) from the Bull. Assoc. de Magnetisme. Omitting doubtful cases it was possible to use 216 SFE's 64 SSC's and 67 SI's for the period 1939-54. For intervals of 5 hr from the start of SFE up to 120 hr later cases of SSC, SI and

and SSC SI have been tabulated. These confirm the results of Hale and his successors of the delay between terrestrial phenomena and chromospheric eruptions. There are maxima at 25-30, 65-70 and 80-85 hr for SSC but only at 25-30 hr for SI. It is considered important to distinguish for a magnetic pertubation and the preceding SFE the cases where it shows as a storm or an isolated impulse. For the first the correlation is weak but the interval of time between the SFE and the SI can be defined with much greater precision and a maximum between 25 and 30 hr later. R.S.Read

523.752

4998. ON THE QUESTION OF THE PHYSICAL NATURE OF CHROMOSPHERE ERUPTIONS. I.M.Gordon.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 813-16 (1954). In Russian.

The accumulation of observation shows that the following effects accompany such eruptions: (1) the blazing up of radio emission; (2) the extinction of radio communication on short wavelengths, apparently by the action of X-rays on the ionosphere; (3) the increase of intensity of the primary component of cosmic ray intensity; (4) the increase of intensity of the continuous spectrum in the optical region. The authors consider that all the main aspects of the process of eruption flow out from the fundamental fact that electrons with relativistic energies are present in these eruptions. The continuous optical spectrum is explained as the emission of luminous electrons, which give a direct optical method of observing the places where cosmic rays are generated. A quantitative examination of this hypothesis is made using formulae due to V.V.Vladimirskiĭ (Abstr. 3303/1950). W.Bardsley

523.774 : 530.12

4999. ON THE RED SHIFT OF THE SOLAR LINES. E.Finlay-Freundlich and E.G.Forbes.
Ann. Astrophys., Vol. 19, No. 4, 183-98 (1956).

A detailed analysis is made of Adam's measurements (Abstr. 4418/1949) and it is found that the observations may be represented in the form $\Delta\lambda = X_\lambda + Y l_\theta / l_0$, where l_θ is the length of path traversed by the light through the solar atmosphere in a direction inclined at θ to the solar radius, X_λ is constant across the disk but varies from -3×10^{-3} A to $+6 \times 10^{-3}$ A for individual lines, and $Y = 2.04 \times 10^{-3}$ A $\pm$ $\pm$ 0.04. A representation of the observations in terms of Doppler effects superposed upon the relativistic red-shift is found to be very unsatisfactory. R.A.Newing

523.774

5000. LYMAN-ALPHA INTENSITY AND SOLAR LIMB DARKENING FROM ROCKET SPECTROGRAMS. S.C.Miller, Jr, R.Mercure and W.A.Rense.
Astrophys. J., Vol. 124, No. 3, 580-5 (Nov., 1956).

From recent rocket spectrograms the intensity of solar Lyman-α radiation has been measured to be 3.0 ergs per cm^2 per sec at 122 km, and the half-width about 0.8 A. Because of special features of the spectrograph design, it was possible to measure solar limb darkening in Lyman-α radiation. The averaged results indicate slight limb brightening, possibly because of an appreciable increase in intensity in Lyman-α radiation in the solar latitudes, which exhibited sunspot activity at the time of the flight. A.

523.774

5001. SPECTROPHOTOMETRY OF SUNSPOTS. NEW IDENTIFICATION OF MgH. G.Laborde.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 564-6 (Jan. 28, 1957). In French.

The presence of the MgH band at 5211 A in the spectra of sunspots, first reported by Tanaka, Nagasawa and Saito (1939), has been confirmed. D.R.Barber

523.775

5002. ON ROHRLICH'S DISCUSSION OF THE CALCIUM XV PROBLEM. D.Layzer.
Astrophys. J., Vol. 124, No. 3, 664-5 (Nov., 1956).

A reply to a criticism by Rohrlich (Abstr. 5641/1956) of the author's procedure (Abstr. 9548/1955) for evaluating a certain parameter in the theoretical formula used to identify the yellow coronal line with Ca XV. D.R.Barber

523.775

5003. SPECTROSCOPIC STUDIES OF THE SOLAR CORONA. G.Righini.
"Vistas in Astronomy", Volume I, 738-47. See Abstr. 10 (1957).

Critical survey of the problems connected with the corona: instruments for direct photography, slit- and slitless-spectrographs, and the electrocoronograph, also in conjunction with a Lyot coronograph, are discussed. New observational results are compared with previously discovered coronal emissions; the intensity ratio between K- and F-corona is formulated; controversial theories are presented. A.Beer

523.83

5004. THE K-EFFECT IN STELLAR MOTIONS. H.F.Weaver.
"Vistas in Astronomy", Volume I, 228-38. See Abstr. 10 (1957).

The various explanations which have been suggested for the K-term are analysed. It is shown that it is important to generalize the moving cluster concept, taking into account physical properties of the stars. If the community motion groups are removed from the data, a K-term of about +2.5 km/sec remains for the O-B2 stars. This may be attributed principally if not entirely to gravitational red-shift in accordance with the general theory of relativity. A.Beer

523.852.2

5005. EXCITATION IN NEBULAE: ELECTRON–HYDROGEN INELASTIC COLLISIONS IN A RADIATIVE H II REGION. J.W.Chamberlain.
Astrophys. J., Vol. 124, No. 3, 662-4 (Nov., 1956).

The relative importance of collisional excitation in planetary nebulae may be expressed by the quantity, $(N_1/N_e)/(N_1/N_e)_{coll}$, where $(N_1/N_e)_{coll}$ is the ratio of neutral atoms to electrons for pure collisional excitation, assuming the density of the latter to be equal to that of ionized atoms. The above parameter is thus dependent not only on the amount of ionization present, but also on the electron temperature. For the very hot stars associated with the planetary nebulae, collisional encounters can be important away from the H II boundary only when the temperature is much higher than 20 000° K. See also Abstr. 8195 (1953). D.R.Barber

523.877

5006. REMARKS ON THE SPHERICAL TRANSFER PROBLEM IN STELLAR ATMOSPHERES. D.Barbier and G.W.Curtis.
Ann. Astrophys., Vol. 19, No. 4, 199-206 (1956). In French.

The source function is derived from that for a plane atmosphere by an iteration calculation, and the correction due to curvature is found to be appreciable at optical depth 0.003, for atmospheres in hydrostatic equilibrium, only when $20Rg/T < 1$, where the radius R is expressed in solar units. R.A.Newing

523.877

5007. ON THE POSSIBLE PRESENCE OF He^3 IN THE MAGNETIC STAR 21 AQUILAE. E.M.Burbidge and G.R.Burbidge.
Astrophys. J., Vol. 124, No. 3, 655-9 (Nov., 1956).

Measurements of the helium lines in the spectrum of the magnetic star 21 Aquilae reveal a wavelength shift between the singlet and triplet lines. Although some part of this shift may be due to Stark effect, comparison with the laboratory measures of isotope shifts between lines of He^3 and He^4 suggests that there is a reasonable probability that the major part of the shift may be due to the presence of He^3 in the star's atmosphere in an amount comparable with that of He^4. Theoretical arguments suggest that the acceleration of protons in the stellar atmosphere will lead to the production of neutrons and deuterons and thence to some synthesis of He^3 through the $H(d,\gamma)He^3$ reaction. A.

523.877

5008. NON-ADIABATIC PULSATIONS IN STARS WITH CONSTANT ADIABATIC EXPONENTS. N.A.Dmitriev, M.I.Feodoritova and D.A.Frank-Kamenetskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 6, 949-51 (1956). In Russian.

A solution is constructed for the equations describing the non-adiabatic small pulsations in a star. Boundary conditions on the surface and in the centre are satisfied. Using various transformations, the equation reduces (for the second order of small quantities) to one of Bessel form. Actual computations are carried out only for the simplest case of constant adiabatic exponent. T.W.Olle

523.877

5009. THE INTENSITY OF EMISSION LINES IN STELLAR SPECTRA. P.Wellmann.
"Vistas in Astronomy", Volume I, 303-13. See Abstr. 10 (1957).

The conditions in an extended stellar atmosphere may be adequately explained by the theory of diluted radiation, if it is postulated that the optical depth in the lines is small enough. In order to check this basic postulate, the dependence of emission intensities on the number of atoms is developed by analogy with the curve of growth for absorption lines, giving a curve of growth for emission lines. This is used in analysing observed emission spectra. Furthermore, relations are developed between line intensity, transition probability, and characteristic data of the atmosphere, describing the difference between various shell spectra and the changes in the spectrum of an expanding atmosphere, and these are used to study the structure of a shell. A generalized equation of ionization has to be introduced for the investigation of emission spectra. A.Beer

523.877

5010. THEORIES OF VARIABLE STELLAR MAGNETIC FIELDS. V.C.A.Ferraro.
"Vistas in Astronomy", Volume I, 330-5. See Abstr. 10 (1957).

Three possible ways of accounting for the variability and reversal of the fields are discussed. The general properties of oscillations of a gaseous star under the combined action of the electromagnetic and gravitational forces are considered and the relevant equations derived; numerical comparisons with magnetic stars are added. Further investigations of the proposed theory are required, and the possibility of the oblique rotator as a model of a magnetic variable should also be considered. A.Beer

523.877

5011. THE PECULIAR A-STARS. A.J.Deutsch.
"Vistas in Astronomy", Volume II, 1421-7. See Abstr. 10 (1957).

The spectra of some A-stars are distinguished by the abnormal strengths of certain absorption lines. Periodic variations of line strength occur in some of these stars, and in a number of cases synchronous variation of a general magnetic field also occurs, together with a small synchronous light-variation. Some evidence is given in support of a model in which the variations arise as the result of the axial rotation of a spectroscopically "patchy" star, which has "frozen" into the material a magnetic field with its axis inclined to the rotational axis. A.Beer

523.877

5012. EMISSION LINES AND STELLAR ATMOSPHERES. G.R.Burbidge and E.M.Burbidge.
"Vistas in Astronomy", Volume II, 1446-56. See Abstr. 10 (1957).

The theoretical condition for a spectrum line to appear in emission is stated in terms of a parameter which measures the departure from thermodynamic equilibrium of the atmosphere. It is shown that only in very hot stars can emission lines arise in what might be called a normal steller atmosphere. A simplified method for deriving approximate values of the extent of the atmospheres in Ae and Be stars from the intensities of the Balmer emission lines is outlined and some applications are described. A simplified theory of the Balmer decrement in these stars is also discussed. In the second part of the paper the different classes of late-type emission objects are characterized, and some physical ideas concerning these are put forward. A.Beer

523.877

5013. THE SPECTRA OF NOVAE. D.B.McLaughlin.
"Vistas in Astronomy", Volume II, 1477-85. See Abstr. 10 (1957).

A systematic survey of all typical novae shows that, in chronological order of appearance, as well as of increasing displacement, the systems of absorption lines are as follows: (1) pre-maximum, (2) principal, (3) diffuse enhanced, (4) Orion. The principal system lies on the short wavelength edges of a strong set of wide, undisplaced emission lines. Structures appear early in the emission, and can be correlated with local knots in the expanding nebulae years later. Diffuse enhanced and Orion lines also have associated, but more vague, emission. Secondary light-variations are correlated with spectral changes. With a re-brightening, the spectrum reverts to a stage already passed. Variations of line displacements accompany these changes. For Orion lines the oscillations are considered real, and due to variable speed of ejection. In the diffuse-enhanced system they are due mainly to variable strength of blended multiple lines. Critical examination fails to confirm supposed rapid gravitational retardation of gases. A.Beer

523.877

5014. ON THE NATURE OF THE PHYSICAL PROCESSES UNDERLYING THE NOVA PHENOMENON. Z.Kopal.
"Vistas in Astronomy", Volume II, 1491-505. See Abstr. 10 (1957).

In this semiqualitative discussion a hypothesis is proposed which identifies the effective photosphere of an expanding "main burst" with the front of a long shock-wave produced by an instantaneous internal explosion. It is pointed out that the observed velocities of expanding gas shells of most novae are such that their motion must be highly supersonic. A suggestion is advanced that the conversion of mechanical energy into heat through the medium of shock waves is the main reason why expanding effective photospheres of the novae may attain their observed sizes without dispersal or adiabatic cooling. As the hypothetical shock-front expands into progressively cooler layers, its Mach number will necessarily grow. And it is the gradual increase in shock strength (caused by the diminishing velocity of sound in front of the wave) which may account for the maintenance of the observed pressures and temperatures. Quantitative aspects of this hypothesis are considered and confronted with the observational evidence. In the second part of the paper some models of pre-novae are constructed. It is pointed out that they show a very high degree of condensation, which strains their hydrostatic equilibrium (triggered by suitable excess pressure) and, together with the events following the immediate absorption of free neutrons by heavy elements, may be the initial cause of a nova outburst. A development of this suggestion reveals that this particular process is not only ample for defraying the energy balance of a single nova outburst, but may also render this phenomenon repetitive. A.Beer

525.3

5015. NOTE ON AN ARTIFICIAL SATELLITE. B.Saelman.
Amer. J. Phys., Vol. 24, No. 9, 630 (Dec., 1956).

The basic problem of the required initial velocity,v, at the altitude, perpendicular to the line from the centre of the earth to the satellite, necessary to force it into a circular orbit, is solved on the assumption of the satellite being above the atmosphere in free space. When fired along the equator in a horizontal direction v = 24470 ft/sec. Period of revolution T of the satellite, as a function of its distance r from the earth's centre, is $T = 2\pi r/v = 2\pi r^{3/2}/g_0^{1/2}R$, where R = earth's radius, g_0 gravity at earth's surface, and v is velocity of satellite perpendicular to line of centres. For the satellite to remain always above the same point of the earth's surface r = ~ 26600 miles. H.H.Hodgson

525.3

5016. OBLATENESS PERTURBATION OF ELLIPTICAL SATELLITE ORBITS. L.Blitzer and A.D.Wheelon.
J. appl. Phys., Vol. 28, No. 2, 279 (Feb., 1957).

The formulae of nodal regression of earth-satellite orbits (due to the oblateness of the earth) in the case of elliptical orbits are deduced, thus extending the analysis of a previous paper (Abstr. 1036/1957). The nodal regression increases with increasing orbital eccentricity. M.W.Ovenden

525.35

5017. THE ATOMIC CLOCK AND THE IRREGULARITY OF THE ROTATION OF THE EARTH. N.Stoyko.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 43-5 (Jan. 2, 1957). In French.

The variations in the rotation of the earth as determined from observations with the caesium frequency standard constructed by Essen at the N.P.L. are compared with the extrapolated values used at the Bureau International de l'Heure to allow for the seasonal irregularity of the earth's rotation. The agreement is very close but the caesium values show more detail. A.H.Cook

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FUNDAMENTALS 530.1

53.08

5018. ON THE PRINCIPLES OF THE INTERPRETATION OF MEASUREMENTS. P.Vernotte.
C.R. Acad. Sci. (Paris), Vol. 244, No. 8, 1017-18 (Feb. 18, 1957). In French.

53.088.3

5019. THE REDUCTION OF EXPERIMENTS BY THE METHOD OF LEAST IMPRECISION OR BY THE METHOD OF LEAST SQUARES. P.Vernotte.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1733-4 (Nov. 26, 1956). In French.

530.12

5020. ON A GENERALISATION OF THE EINSTEIN—INFELD APPROXIMATION METHOD. A.Trautman.

Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 7, 439-42 (1956).

The restriction that expansions involve only odd or even powers of the parameter is removed, and the zero-order approximation to the metric tensor is given for non-Cartesian coordinate systems. R.A.Newing

530.12

5021. SOLUTION OF ONE-BODY PROBLEM BY THE EINSTEIN–INFELD APPROXIMATION METHOD. A.Trautman.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 7, 443-6 (1956).

The Schwarzschild metric is derived as an illustrative application of the generalized method (see preceding abstract). R.A.Newing

530.12 : 538.3

5022. ON THE THEORY OF THE ELECTROMAGNETIC FIELD IN MOVING DIELECTRICS. J.I.Horváth.
Bull. Acad. Polon. Sci. Cl. 3, No. 7, 447-52 (1956).

A new relativistic Lagrangian is given for the field in interaction with polarizable matter. It leads to the Abraham rather than the Minkowski energy-momentum tensor; contrary to arguments of other authors, the conservation laws are unable to decide between these. J.S.Bell

530.12

5023. ON MODIFIED DIRAC δ-FUNCTIONS. L.Infeld and J.Plebański.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 10, 687-91 (1956).

It is shown that by narrowing the concept of the δ-functions they can be given additional properties which are useful when applying them, especially when dealing with certain infinities. P.M.Davidson

530.12

5024. ON A COVARIANT FORMULATION OF THE EQUATIONS OF MOTION. L.Infeld and J.Plebański.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 11, 757-62 (1956).

The relativistic field equations for singularities are formulated in terms of the modified Dirac δ-function (see preceding abstract). It is shown that under certain conditions the equations of motion derived by the Einstein–Infeld–Hoffman method are necessarily the same as those derived from a geodesic principle. R.A.Newing

530.12

5025. ON THE "DIPOLE PROCEDURE" IN GENERAL RELATIVITY THEORY. L.Infeld and J.Plebański.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 11, 763-7 (1956).

The approximation procedure for the derivation of equations of motion from the field equations is expressed in a covariant manner by using the covariant formulation developed by the authors (see preceding abstract). R.A.Newing

530.12 : 531.51

5026. AN APPROXIMATE SOLUTION IN EINSTEIN'S FIELD THEORY OF 1953. R.Tiwari.
Curr. Sci., Vol. 25, No. 12, 389-90 (Dec., 1956).

The solution considered represents the interaction between a uniform electromagnetic field of monochromatic radiation and the gravitational field of a point mass. The solution obtained for the gravitational field involves a line singularity, and it is noted that the solution is the transform of the Schwarzschild field by a singular transformation. R.A.Newing

530.12

5027. FORMS OF RELATIVISTIC DYNAMICS REFERRED TO THE NEW FUNDAMENTAL GROUP OF TRANSFORMATIONS. T.Shibata and T.Kimura.
J. Sci. Hiroshima Univ. A, Vol. 20, No. 2, 85-92 (Oct., 1956).

530.12 : 531.51

5028. A GENERALIZATION OF REISSNER–NORDSTRÖM SOLUTION. I. R.L.Brahmachary.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1216-18 (Nov., 1956).

It is pointed out that two special singularity-free solutions of Einstein's gravitational field equations can be obtained without difficulty. P.T.Landsberg

530.12

5029. ON THE HIGHER LIMIT FOR THE MASS OF AN ASSEMBLY OF PARTICLES. G.Bussetti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1613-14 (Dec., 1956).

It follows from the author's previous results (Abstr. 686/1954) that this limit is $\sim 10^{35}$ g. It is also shown that this result, derived in the domain of special relativity, is not substantially changed in general relativity. L.Pincherle

530.12

5030. ON THE EMPIRICAL FOUNDATION OF THE GENERAL THEORY OF RELATIVITY. E.Finlay-Freundlich.
"Vistas in Astronomy", Volume I, 239-46. See Abstr. 10 (1957).

A new analysis of the observational data is given. While the prediction of the general theory of relativity concerning the more accurate law of the orbital motion of a small body around the sun appears to be in full agreement with the observations, the predictions of effects of a fundamentally new character, concerning the motion of photons in the gravitational field of the sun, have not yet been safely confirmed. The existence of a general systematic red-shift of all solar lines relative to the corresponding terrestrial lines, amounting to $2.12 \times 10^{-6}\ \lambda$, has not yet been established. The measurements indicate a small red-shift of the solar lines, but its amount varies across the sun's disk, and appears affected by superimposed effects of a different character. At the sun's limb, however, where Doppler- and pressure-effects should become insignificant, the observed red-shift does not converge towards the predicted relativity value. Concerning the light deflection: its existence is established with certainty, but its quantitative value is not yet fixed; the observations indicate 2".2, which is 25% larger than the theoretically-predicted relativity value. The increasing accuracy of recent determinations tends to support the reality of this discrepancy. New observational tests are suggested. A.Beer

530.12 : 523.112

5031. SINGULAR STATE IN RELATIVISTIC COSMOLOGY. A.Raychaudhuri.
Phys. Rev., Vol. 106, No. 1, 172 (April 1, 1957).

It is noted that Komar's conclusion concerning the necessary occurrence of singularities (Abstr. 1043/1957) was anticipated in an earlier paper by the author (Abstr. 5818/1955). R.A.Newing

530.12

5032. GENERAL RELATIVISTIC RED SHIFT AND THE ARTIFICIAL SATELLITE. B.Hoffmann.
Phys. Rev., Vol. 106, No. 2, 358-9 (April 15, 1957).

Singer's formula (Abstr. 1042/1957) for the general relativistic red-shift on an earth satellite is modified to take account of the diurnal rotation of the earth and the lack of spherical symmetry of its gravitational field. It is shown that the Singer rates of the earth and satellite clocks need slight modifications, but that these modifications tend to cancel each other except at large distances from the earth, so that when one uses a mean radius of the earth in Singer's formula the formula is adequate for present purposes. A.

530.145

5033. FALL OF PARITY. L.S.Rodberg and V.F.Weisskopf.
Science, Vol. 125, 627-32 (April 5, 1957).

Gives a simplified account of the principle of parity and recent experiments that have brought about a change of view as to the nature of this fundamental concept.

530.145

5034. THE EQUATIONS OF MOTION OF THE POLE–DIPOLE PARTICLE. K.Nagy.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 10, 683-5 (1956). In German.

The equations of motion of the pole–dipole particle are set up by the method of Infeld (Abstr. 7678/1955). P.M.Davidson

530.145

5035. SYSTEMS OF COVARIANT EQUATIONS IN QUANTUM FIELD THEORY. B.L.Ioffe.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 4, 761-4 (1954). In Russian.

The various covariant integral equations of field theory are reviewed. Equations analogous to those of Tamm–Dancoff theory have been described by various authors (e.g. Dyson, Abstr. 5854/1953). In every case the propagation [Green] function satisfying the equations can be derived from Schwinger's basic dynamical principle for the theory of fields. Covariant equations for two-particle Green functions can also be formulated. J.W.Gardner

530.145

5036. FUNCTIONAL METHODS IN FIELD THEORY. R.Cirelli and M.Pusterla.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1601-4 (Dec., 1956). In Italian.

In the recently developed functional approach to field theory all observational quantities predicted by the theory are contained in certain Green functions which can be expressed using the technique of functional integration. The present paper discusses the evaluation of such functional integrals in the case of boson fields. J.W.Gardner

530.145

5037. A NEW PROOF OF THE ONE-TIME EQUATION IN THE THEORY OF BOUND STATES. W.Królikowski and J.Rzewuski.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1212-15 (Nov., 1956).

In the earlier proofs by the authors (Abstr. 9409/1955, 4183/1956) it was essential that the integral equations are inhomogeneous, which excludes bound states. Avoiding the intermediary of integral equations, the new proof is designed to cover also bound states. W.A.Hepner

530.145

5038. EXPANSION OF SINGULAR FUNCTIONS ASSOCIATED WITH THE KLEIN-GORDON EQUATION. L.Infeld and J.Plebański.
Acta phys. Polon., Vol. 15, No. 4, 207-48 (1956).

Two alternative approximation methods involving expansions in powers of c^{-1} or c are given for the Klein–Gordon equation. By using these methods, expansions of the more important singular functions such as $\bar{\Delta}$, Δ, and $\Delta^{(1)}$ are obtained. The connection is shown between this procedure and two alternative methods for formally integrating the Klein–Gordon equation on the basis of analogies with the Yukawa and the harmonic oscillator equations. The main purpose of this paper is to prepare the mathematical basis for the subsequent application of the Einstein–Infeld–Hoffman method to the equations of motion in meson theory. A.

530.145

5039. RELATIVISTIC TWO-BODY PROBLEM IN ONE-TIME FORMULATION. SEPARATION OF ANGULAR VARIABLES IN THE CASE OF ONE-QUANTUM INTERACTION IN ELECTRODYNAMICS. W.Królikowski and J.Rzewuski.
Acta phys. Polon., Vol. 15, No. 5, 321-41 (1956).

The separation of angular variables in the relativistic one-time equation for the two-fermion problem in quantum electrodynamics is carried out for the case of one-quantum interaction. The momentum representation is used. A system of integral equations in one variable is obtained. This system reduces to four equations in the case of $j = 0$, and to eight equations for $j \neq 0$. A.

530.145

5040. ASYMPTOTIC INVESTIGATION OF VERTEX PART IN QUANTUM ELECTRODYNAMICS. V.Z.Blank and D.V.Shirkov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1201-4 (1956). In Russian.

A method of "group" renormalization is proposed for the functional equations of quantum electrodynamics. The Green function for point particles is obtained as an asymptotically limiting case, subject to the usual covariance restrictions. J.W.Gardner

530.145

5041. PLURAL INTERACTION HAMILTONIANS IN QUANTUM ELECTRODYNAMICS. G.F.Filimonov and Yu.M.Shirokov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 99-104 (1957). In Russian.

A method is described for constructing electromagnetic interaction Hamiltonians of a many-particle system, based on the usual Hamiltonian formalism. For illustration the Hamiltonian for pair interaction of spinor particles is derived. A.

530.145

5042. GENERALIZATIONS OF THE VIRIAL THEOREM. R.M.Schectman and R.H.Good,Jr.
Amer. J. Phys., Vol. 25, No. 4, 219-25 (April, 1957).

This paper is a review of three generalizations of the classical virial theorem of Clausius, the first to a continuous distribution of charge and mass moving with relativistic velocity and its associated electromagnetic field, the second to a single Dirac particle in an external electromagnetic field, and the third to a quantum-mechanical system of particles in a box. Various limiting cases are discussed and tensor versions of the theorem are given where applicable. A.

530.145

5043. SOME REMARKS ON THE THEORY OF THE ELECTRON–PHOTON CASCADE. J.Łopuszański.
Acta phys. Polon., Vol. 15, No. 3, 177-80 (1956).

The well known integro-differential equations for the first moments of the distribution for the electron–photon cascade are derived from an integral equation analogous to the Smoluchowski equation from the theory of stochastic processes. Some asymptotic properties of the distribution function are given. A.

530.145

5044. SOME PROPERTIES OF DISTRIBUTION FUNCTIONS OF ELECTRON–PHOTON CASCADES AT LARGE ABSORBER DEPTH. H.Stachowiak.
Acta phys. Polon., Vol. 15, No. 3, 181-90 (1956).

It is shown that at large depth of absorber, the number of particles found in electron-photon cascades depends only on the spectrum of the primary photons, and that at large depths, the number of particles decreases rapidly as the energy of the particles increases. See also preceding abstract. A.

530.145

5045. SOME REMARKS ON THE ASYMPTOTIC BEHAVIOUR OF THE ELECTRON–PHOTON CASCADE FOR LARGE DEPTH OF THE ABSORBER. H.Konwent and J.Łopuszański.
Acta phys. Polon., Vol. 15, No. 3, 191-203 (1956).

It is shown that

$$\lim_{x \to \infty} \frac{S^{(i,2)}(\epsilon',x)}{S^{(i,1)}(\epsilon,x)} = 0 \qquad \text{for } \epsilon' > \epsilon$$

and

$$\lim_{x \to \infty} \frac{S^{(i,2)}(\epsilon,x)}{S^{(i,1)}(\epsilon,x)} = \infty,$$

where $S^{(i,k)}(\epsilon,x)$ denote the first moments for the electron–photon cascade, and further that the probability distribution function $P^{(i,k)}(n,m \mid \epsilon,x)$ has the form

$$P^{(i)}(0,0 \mid \epsilon,x) \sim 1$$
$$P^{(i)}(0,1 \mid \epsilon,x) \sim S^{(i,2)}(\epsilon,x)$$
$$P^{(i)}(n,m \mid \epsilon,x) = o(P^{(i)}(0,1 \mid \epsilon,x))$$

for $(n,m) \neq (0,1)$ and $n + m > 0$. See also two preceding abstracts. A.

530.145

5046. CHARACTER OF THE INTERACTION POTENTIAL BETWEEN ELECTRON AND PHOTON. J.Wrzecionko.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 10, 669-74 (1956).

Photon–electron scattering is treated by the Tamm–Dancoff method as used by Dyson et al. (Abstr. 10806/1954) for the meson–nucleon case. J.S.Bell

530.145

5047. STUDY OF NUCLEON–NUCLEON INTERACTION WITH A SIMPLE ELECTRODYNAMIC MODEL OF THE NUCLEON. J.Charon.
J. Phys. Radium, Vol. 17, No. 10, 887-92 (Oct., 1956). In French.

The nucleon is considered as an assembly of positive and negative electrons. The charge assembly is shown to be stable if the velocities of the particles are close to the velocity of light. The nucleon–nucleon interaction is studied assuming it to be due to exchange of the charge. The forces are shown to be attractive for singlet and triplet states of the n,n, n,p and p,p systems. The binding energy of the n,p system in the $^3S_1$ state is shown to be greater than that for the n,n and p,p systems. The model is justified by calculating the nucleon radius and spin, the deuteron binding energy and quadrupole moment and the α-particle binding energy. L.L.Gree

530.14

5048. CHEW–LOW FORMALISM FOR TWO INTERACTIONS. S.D.Drell and F.Zachariasen.
Phys. Rev., Vol. 105, No. 4, 1407-9 (Feb. 15, 1957).

An extension of the method of Chew and Low is developed for interacting boson–fermion systems for which a portion (H_1) of the interaction can be treated exactly and is included in the zero-order problem. It is applied to the scalar pair term of meson theory. A

530.14

5049. ENERGY OF INTERACTING FERMI SYSTEMS. C.DeDominicis and P.C.Martin.
Phys. Rev., Vol. 105, No. 4, 1417-19 (Feb. 15, 1957).

The energy of systems of interacting Fermi particles can be calculated by expanding in powers of the ratio of the distance betwe particles to the distance between scatterings. Results are given fo a gas consisting of particles with a pure hard-core interaction. J.M.Casse

530.1

5050. REMARKS ON POSSIBLE NONINVARIANCE UNDER TIM REVERSAL AND CHARGE CONJUGATION. T.D.Lee, R.Oehme and C.N.Yang.
Phys. Rev., Vol. 106, No. 2, 340-5 (April 15, 1957).

Interrelations between the nonconservation properties of parit time reversal, and charge conjugation are discussed. The results are stated in two theorems. The experimental implications for th $K-\bar{K}$ complex are discussed.

530.145 : 517.6

EVALUATION OF CONFIGURATION INTEGRALS FOR A SYSTEM OF PARTICLES WITH COULOMB INTERACTION. See Abstr. 4961

530.145

5051. THE REPRESENTATION LEADING TO ISOBARS OF THE NUCLEON IN THE FIXED-SOURCE THEORY. W.Królikowski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 1, 55-8 (1957).

Using the symmetrical pion theory, it is shown that there exist four isobars of the physical nucleon. The approximation used differs from the strong-coupling approximation (W.Pauli and S.M.Dancoff, Phys. Rev., Vol. 62, 85, 1942), and depends on splitting the interaction Hamiltonian into two parts. The first gives four potentials that lead to four sets of states containing the ground states of four stable isobars of the physical nucleon, while the second part, if small, causes "slow" transitions between these four sets of states. W.A.Hepner

530.145

5052. THE SEPARATION OF NON-INTERACTING PION DEGREES OF FREEDOM IN THE FIXED-SOURCE THEORY. W.Królikowski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 5, No. 1, 59-63 (1957).

Continuing the previous paper (see preceding abstract), the pion field (symmetrical, pseudoscalar) is split into three kinds of oscillators: interacting directly with the nucleon, interacting indirectly and non-interacting. The nine oscillators of the first kind, together with the source, are proposed as an approximate model for the four isobars of the physical nucleon. W.A.Hepner

530.145

5053. ON THE STATIONARY STATES OF A PARTICLE IN AN ENCLOSURE AND THE THEORY OF THE DOUBLE SOLUTION. A.Rot.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1281-4 (Oct. 29, 1956). In French.

Extension to the case of separable variables of results obtained by de Broglie and the author in the case of a sphere; (see Abstr. 112/1957). J.S.Bell

530.145

5054. ON A POSSIBLE GENERALIZATION OF THE WEYSSENHOFF THEORY OF FLUIDS WITH SPIN. G.Karpman and V.V.Raman.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1284-7 (Oct. 29, 1956). In French.

Generalized equations of motion are derived for the case in which the time components of the spin tensor do not vanish in the rest-frame. R.A.Newing

530.145

5055. STUDY OF THE PROCA FLUID. G.Jakobi.
C.R. Acad. Sci. (Paris), Vol. 244, No. 8, 1014-16 (Feb. 18, 1957). In French.

A study of the fluid formed by an assembly of points obeying the equations of Proca's theory. P.M.Davidson

530.145

5056. APPROXIMATE EXPRESSION FOR GREEN FUNCTION IN THE NEUTRON KINETIC EQUATION. Kh.Ya.Khristov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1197-200 (1956). In Russian.

An iterative solution, involving repeated applications of the integral operator Φ is described for the kinetic equation $W - A - \Phi W = 0$ (A is an auxiliary δ-function imposed by the physical boundary conditions). A starting function W_0 is proposed, and justified, and using this the first iterate W_1 is worked out explicitly. J.W.Gardner

530.145

5057. THE PHYSICAL SIGNIFICANCE OF DIRAC'S RELATIVISTIC EQUATION FOR THE ELECTRON. J.Charon.
J. Phys. Radium, Vol. 17, No. 10, 893-8 (Oct., 1956). In French.

The Dirac equation can be regarded as describing a singularity in a relativistic field of the universe, and can be obtained by employing a simple model of the universe, in which the electron is regarded as a single point. An interpretation of the wave-function Ψ can be deduced. P.M.Davidson

530.145

5058. ON THE DETERMINATION OF THE WAVE-FUNCTIONS OF A PARTICLE OF SPIN $\hbar$ IN INTERACTION WITH A CONSTANT MAGNETIC OR ELECTRIC FIELD. G.Petiau.
J. Phys. Radium, Vol. 17, No. 11, 956-64 (Nov., 1956). In French.

The wave-functions are determined for a charged particle of spin one in a constant uniform electric or magnetic field. The results are compared with those for the Dirac electron. J.S.Bell

530.145

5059. ON THE CONSERVATION OF THE NUCLEONS. B.Ferretti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 951-2 (Oct., 1956).

It has been investigated whether a procedure could be defined using nucleons as the sources of fields whose equations could satisfy the law of conservation. One has been defined for the measurement of the nucleonic four-current independent from the equations of motion of the matter field, only if the source of the created field is the four-current itself, since the commutation relations of the four-current components with other expressions (scalar, etc) formed with the matter field, depend on the equation of motion of this field. This research agrees with Yang and Lee's discussion of the nucleonic conservation, but its conclusions are not relevant to a general principle, from which, both the field structure and the law of conservation may be derived. J.J.Phipps

530.145 : 539.18

5060. DISPERSION RELATIONS FOR DECAY PROCESSES. E.Corinaldesi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1605-7 (Dec., 1956).

It is shown that there are dispersion relations, analogous to those of scattering, for reactions in which a particle disappears and at least three others are produced. As an example the meson decay $\tau \rightarrow 3\pi$ is considered. J.S.Bell

530.145 : 538.3

5061. PARTICLE ASPECT OF THE ELECTROMAGNETIC FIELD EQUATIONS. R.H.Good, Jr.
Phys. Rev., Vol. 105, No. 6, 1914-19 (March 15, 1957).

In this paper it is shown that Maxwell's theory of the electromagnetic field in vacuum can be stated in a form closely parallel to Dirac's theory of the electron. The electromagnetic field is described by a three-by-one column matrix whose elements are linear combinations of the three independent spinor components of the field. The Maxwell equations take a form similar to the Dirac equation for a free electron but involving three-by-three matrices. In terms of a wave-function normalized so that the integral-square is the number of photons, the classical expressions for the energy, momentum, and angular momentum in the field are related to expected values of the Hamiltonian, momentum, and angular momentum operators. The angular momentum operator consists of an orbital part plus a three-by-three spin-one matrix part. As in Dirac's theory, the contributions from the states of negative Hamiltonian eigenvalue must be subtracted — these are states of opposite circular polarization. A.

530.145

5062. STUDY OF MULTIPLE MESON TERMS IN THE EQUATION OF CHEW AND LOW. R.Omnes.
C.R. Acad. Sci. (Paris), Vol. 243, No. 15, 1019-20 (Oct. 8, 1956). In French.

The Tamm—Dancoff method gives too low a value for the production of an extra meson by meson—nucleon collision. For this reason the author studies multiple meson terms of the equation of Chew and Low (Abstr. 2680/1956). An integral equation of the Fredholm type is derived for the matrix elements for the reaction cross-section. Numerical results are not given. H.Motz

530.145

5063. DISPERSION RELATIONS FOR NUCLEON—NUCLEON SCATTERING. F.M.Kuni.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 3, 571-4 (1956). In Russian.

The generalized Kramers—Kronig dispersion relations for charged bosons have been successfully adapted to pion—nucleon scattering (Abstr. 2439, 8509/1955). Nucleon—nucleon scattering could in principle be treated by the same methods which, however, would now be much more laborious due to the many possible intermediate states. The present paper adopts a new approach of introducing certain "non-physical" amplitudes $A_{NN}(w)$, $A_{AN}(w)$, etc. associated with the mutual scattering of nucleons and anti-nucleons, where the energy w may, and indeed must in some cases be negative. In the T-matrix [related to the S-matrix by $T = i(1-S)$] the A's appear only in symmetric combinations, which greatly facilitates calculation of the dispersion relations; all non-physical terms mutually cancel. J.W.Gardner

530.145

5064. APPLICATION OF CAUSALITY ARGUMENTS TO DELBRÜCK SCATTERING. A.Claesson.
K. Fysiogr. Sällsk. Lund Förhandl., Vol. 27, Paper 1, 9 pp. (1957).

The calculation of the cross-section for Delbrück scattering is

carried out with the aid of the principles of causality. This implies that the absorptive part of the scattering amplitude is first calculated by a straightforward computation. This can be done without encountering any infinities. The rest of the scattering amplitude is then written as an integral over all energies of the absorptive term. The form of this integral permits one to isolate and eliminate directly the well-known non-gauge-invariant and divergent terms in the theory. The remaining terms are finite and can, in principle, be computed. A.

530.145

5065. ON THE RESONANCE NUCLEON–NUCLEUS SCATTERING. E.Minardi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1219-21 (Nov., 1956).

The possibility of applying to this problem the solution for the S'-matrix found in a previous paper (Abstr. 2687/1956) is discussed. It is shown that the procedure seems reliable when reaction processes in nuclear matter exist, e.g. if one assumes, in zero approximation, the complex potential of the nuclear model of Feshbach, Porter and Weisskopf. W.A.Hepner

530.145

5066. RELATIVISTIC THEORY OF MESON–NUCLEON SCATTERING. S.F.Edwards and P.T.Matthews.
Phil. Mag. (Eighth Ser.), Vol. 2, 467-72 (April, 1957).

An effective range theory of low energy meson–nucleon scattering is developed based on the relativistic pseudo-scalar interaction. An approximate relativistic equation is derived which, unlike the ladder approximation to the Bethe–Salpeter equation, preserves crossing symmetry. The equation is solved approximately and all divergences are removed by renormalization before going to the low energy limit. The resulting equations for the phase shift depend on only one parameter — the coupling constant. With a suitable choice of this constant the p-wave phases, in particular that of the $\frac{3}{2},\frac{3}{2}$ phase, are in good agreement with experiment. The s-wave phases are of the right order of magnitude, but do not show the observed strong dependence on isotopic spin. A.

530.145

5067. SATURATION OF NUCLEAR FORCES. C.DeDominicis and P.C.Martin.
Phys. Rev., Vol. 105, No. 4, 1419-20 (Feb. 15, 1957).

The properties of nuclear matter have been calculated on the assumption that two-body interactions are dominant. The forces are chosen to fit the deuteron and, so far as they are understood, the high energy nucleon–nucleon scattering data. A density of nuclear matter approximately equal to that observed comes out of the calculations. J.M.Cassels

530.145

5068. MEANING OF THE SOLUTIONS OF LOW'S SCATTERING EQUATION. F.J.Dyson.
Phys. Rev., Vol. 106, No. 1, 157-9 (April 1, 1957).

The meaning of the "redundant" solutions of Low's scattering equation is clarified, by constructing a model in which every one of these solutions may be the physically correct one. A.

530.145

5069. THE FIRST PASSAGE PROBLEM IN THE THEORY OF MULTIPLE SCATTERING. J.C.Barton.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 253-61 (April, 1957).

A new formal method of solving first-passage problems is developed and applied to the multiple scattering equation for the simplest cases of single- and double-sided boundaries. The latter problem is also treated by an alternative method which enables the moments of the distribution to be calculated more readily. A.

530.145

5070. DERIVATION OF THE BRUECKNER MANY-BODY THEORY. J.Goldstone.
Proc. Roy. Soc. A, Vol. 239, 267-79 (Feb. 26, 1957).

An exact formal solution is obtained to the problem of a system of fermions in interaction. This solution is expressed in a form which avoids the problem of unlinked clusters in many-body theory. The technique of Feynman graphs is used to derive the series and to define linked terms. The graphs are those appropriate to a system of many fermions and are used to give a new derivation of the Hartree–Fock and Brueckner methods for this problem. A.

530.145

5071. GENERALIZED REGULAR SOLUTIONS FOR A POINT CHARGE IN GENERAL-RELATIVISTIC SCALAR MESON-FIELD THEORY. Duan'-I-Shi.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1098-9 (1956). In Russian.

Shirokov (Abstr. 45/1949) has obtained solutions of the Schwarzschild–Nordström type for a point charge without singularities in combined electromagnetic and gravitational fields. The present paper extends the method to the scalar meson field by a suitable choice of solving function, free of discontinuities. J.W.Gardner

530.145

5072. ON CONSTRUCTION OF THE SCATTERING MATRIX. II. NON-LOCAL INTERACTION THEORY. B.V.Medvedev.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 87-98 (1957). In Russian.

For Pt I see Abstr. 3006 (1957). N.N.Bogolyubov's method for constructing the scattering matrix is generalized for the case of non-local interaction theory. A scattering matrix is constructed in this theory which satisfies physically the necessary conditions. A.

530.145

5073. ON RELATIVISTIC WAVE EQUATIONS WITH A MASS SPECTRUM. V.L.Ginzburg.
Acta phys. Polon., Vol. 15, No. 3, 163-75 (1956).

The question of relativistic wave equations having a mass spectrum and containing new continuous variables is discussed. Mostly the case for which the new variables are components of some space-like four-vector is considered, since similar equations have been very often used in recent times in connection with attempts to build a non-local field theory. A.

530.145

5074. ON A SPACE–TIME REPRESENTATION OF NON-RELATIVISTIC WAVE MECHANICS. H.L.Armstrong.
Amer. J. Phys., Vol. 25, No. 3, 195-9 (March, 1957).

A space–space representation is developed for nonrelativistic wave mechanics as was done for classical mechanics, by adding to the system a rotating body to serve as a clock, and applying the time-independent forms of the equations of motion. The usual Schrödinger equation is obtained in this way, however, only in the limit as the energy of the clock becomes very large. The reason for this restriction is found in an appendix, by comparison with the classical equations. Other appendices deal with certain aspects of the Hamiltonian representation of the problem. A.

530.145

5075. ON THE FORCES BETWEEN POTENTIAL WELLS WHICH SHARE A PARTICLE. B.Chao.
Amer. J. Phys., Vol. 25, No. 4, 249-53 (April, 1957).

The famous exchange forces arise in quantum mechanics from the uncertainty at any given time as to which of the two potential wells a particle, which is capable of leaking back and forth between the two wells, is occupying. This entirely quantum-theoretical result can be given an energetic explanation, and in fact be estimated quantitatively, by finding the possible energy eigenfunctions for the particle, which correspond to nearly-equal or to nearly-opposite probability amplitudes for the wave-function in each of the two wells. The variation of system energy with the separation of the wells can be interpreted as a force. The present paper is an effort to give a much more intuitive account of the origin of these important forces. The force is here interpreted purely kinematically as the result of the fact that the particle bombards the well edges both from within and from without. The net attractive or repulsive force between the wells then arises from the fact that for one type of wave-function the bombardment is more frequent on the inner, facing edges, and so the wells are forced together, and conversely for the other type. The ideas are generalized to wells other than the idealized square potential well, and compared quantitatively with more familiar treatments of the problem. A.

530.145

5076. THE REALISM OF SPACE-TIME: ON TWO PROBLEMS OF INTERPRETATION IN WAVE MECHANICS.
O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1838-40 (Dec. 5, 1956). In French.

Microscopic phenomena are regarded as rigorously symmetric in past and future, the retarded actions of macroscopic physics being statistical effects. This point of view is applied in a discussion of certain classical quantum mechanical paradoxes. R.A.Newing

530.145

5077. THE CAUSAL INTERPRETATION OF WAVE MECHANICS. M.Bunge.
Cienc. e Invest., Vol. 12, No. 10, 448-57 (Oct., 1957). In Spanish.

530.145 : 531.31

5078. ON THE BASIC FORMULATION OF CLASSICAL AND QUANTUM THEORIES. I.Fujiwara.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1575-9 (Dec., 1956).

An attempt to give a method of passing directly from a classical Lagrangian to a quantum-mechanical transformation function. The method depends on a certain relationship between the Lagrangian equations of motion and the Schrödinger equation. P.T.Landsberg

530.145 : 530.162

5079. MANY-BODY PROBLEM IN QUANTUM MECHANICS AND QUANTUM STATISTICAL MECHANICS. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 105, No. 3, 1119-20 (Feb. 1, 1957).

The results are given of a "binary collision expansion" method for the quantum mechanical calculation of the fugacity coefficients of a Bose, a Fermi and a Boltzmann gas at low temperature, assuming a hard sphere interaction. This method also yields the ground state energy and wave-function, and information about the density of energy levels near the ground state. W.A.Hepner

530.145

5080. DENSITY MATRIX AND THE MANY-BODY PROBLEM. R.H.Tredgold.
Phys. Rev., Vol. 105, No. 5, 1421-3 (March 1, 1957).

The application of the two-particle density matrix to the calculation of approximate ground states for many-body systems is discussed. It is shown that the subsidiary conditions employed by Mayer (Abstr. 1498/1956) in this context are insufficient to ensure that a valid result is obtained. The formulation of adequate subsidiary conditions presents considerable difficulty. A.

530.145

5081. TRANSITION FROM QUANTUM TO "CLASSICAL" PARTITION FUNCTION. R.W.Zwanzig.
Phys. Rev., Vol. 106, No. 1, 13-15 (April 1, 1957).

The quantum mechanical partition function for a system of interacting electrons and nuclei is examined in the "classical" limit, in which $\hbar \to 0$ in the nuclear kinetic energy operator while $\hbar$ is constant in the electronic kinetic energy operator. It is shown that in the "classical" limit, the apparent nuclear potential energy which appears in the partition function is actually the free energy of the electrons in a system of fixed nuclei, as a function of nuclear configuration and temperature. The lowest order quantum correction is obtained. The effect of the adiabatic approximation is studied; it leads to the correct "classical" limit but a formally inexact lowest order quantum correction. A.

530.145

5082. PERTURBATION THEORY FOR A ONE-DIMENSIONAL PROBLEM OF QUANTUM MECHANICS AND THE METHOD OF LAGRANGE. Ya.B.Zel'dovich.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1101-3 (1956). In Russian.

The regular solution of the problem is presented as the sum of two solutions of the unperturbed problem with variable coefficients. The proposed method gives known expressions for variation of energy in the discrete spectrum to first approximation and for the variation of scattering phase in the continuous spectrum.

Z.Krasucki

530.145

5083. QUANTUM CORRECTIONS TO THE THOMAS—FERMI EQUATION. D.A.Kirzhnits.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 115-23 (1957). In Russian.

The operator form of the Hartree—Fock equations is considered. The Thomas—Fermi and Thomas—Fermi—Dirac equations have been obtained in the zero approximation in terms of $\hbar$. Quantum corrections to the second and fourth order (with respect to $\hbar$) Thomas-Fermi equations have been determined by the operator method. The second-order correction is compared with the Weizsäcker correction and the latter is found to be nine times larger than the quantum theory value. The obtained equations are used to calculate the total energy of the atom. A.

530.16 : 536.7

5084. ON THE EQUIVALENCE BETWEEN INFORMATION AND ENTROPY AND ON IRREVERSIBILITY IN PHYSICS. O.Costa de Beauregard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1728-30 (Nov. 26, 1956). In French.

J.von Neumann's and L.Brillouin's representations of the process of physical measurements are compared. It is shown that the macroscopic principle of retarded potentials is equivalent to that of the increase of entropy. S.Weintroub

530.16

5085. A METHOD FOR THE STUDY OF VARIOUS INTERACTION PROBLEMS. M.Jessel.
J. Phys. Radium, Vol. 17, No. 12, 1022-3 (Dec., 1956). In French.

The main ideas behind the method are outlined, and an example given is the application to Helmholtz' equation. The method avoids certain difficulties of the classical method. It is applicable to Maxwell's equations, and to most wave-equations. L.S.Goddard

530.162

5086. APPLICATION OF BORN'S METHOD TO VARIOUS PROBLEMS IN PROPAGATION. M.Jessel.
J. Phys. Radium, Vol. 17, No. 10, 911-12 (Oct., 1956). In French.

A great variety of problems may be treated by a method essentially similar to Born's approximation method for the treatment of atomic collisions. In particular it may be applied to such problems as the propagation of electromagnetic waves in a troposphere with dielectric constant varying in space. P.M.Davidson

530.162

5087. GROUND-STATE ENERGY OF A HARD-SPHERE GAS. F.J.Dyson.
Phys. Rev., Vol. 106, No. 1, 20-6 (April 1, 1957).

Rigorous lower and upper bounds are established for the energy of the ground state of a Bose gas with hard-sphere interaction between particles. A.

530.162

5088. ON THE QUANTUM-STATISTICAL ERGODIC AND H-THEOREMS. I.E.Farquhar and P.T.Landsberg.
Proc. Roy. Soc. A, Vol. 239, 134-44 (Feb. 12, 1957).

Metrical indecomposability is a condition for the validity of the classical ergodic theorem. Its counterpart in the quantum-statistical theorem is believed to be non-degeneracy of the energy eigenvalues. It is shown here, however, that the coarse-grained quantum-statistical theorems (due to von Neumann and to Pauli and Fierz) remain valid in the presence of energy degeneracy. This requires, therefore, a reassessment of the significance of these theorems; this is discussed, and it is concluded that the von Neumann approach is unsatisfactory in that it fails to yield a microscopic criterion for either ergodicity or validity of the H-theorem. A.

530.162 : 517.6

INTEGRALS OVER THE FERMI FUNCTION. See Abstr. 4960

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.221

5089. THE ASYMMETRY OF THE STRESS TENSOR AND ITS CONSEQUENCES. Y.Le Corre.
J. Phys. Radium, Vol. 17, No. 11, 934-9 (Nov., 1956). In French.

It is supposed that the forces acting across any small surface drawn in an elastic solid do not have a simple resultant (i.e., that an associated couple must be taken into account), and that the usual stress tensor can in some sense then be replaced by an asymmetric tensor. Consequences are an increase in the number of elastic constants associated with each type of crystal symmetry, and different velocities of propagation of elastic waves in crystals. J.G.Oldroyd

531.224

5090. ON THE CORRECTION OF THE SUPPORT IN BENDING TESTS. P.Le Rolland, É.Plenard and P.Pesenti.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1721-3 (Nov. 26, 1956). In French.

Observations show that the bending of a beam fixed at definite points is affected by these supports. In calculations it is necessary to replace the free length l by a corrected length $l + \epsilon$. Details are given of the correction ϵ, which for a rod is stated to be dependent only on the radius and independent of both the length and flexural forces. H.G.Jerrard

531.25 : 535.55

5091. A PHOTOELASTIC METHOD EMPLOYING SCATTERED LIGHT FOR THE SOLUTION OF PLANE STRESS PROBLEMS. W.Shelson.
Brit. J. appl. Phys., Vol. 7, No. 12, 436-9 (Dec., 1956).

A new photoelastic method for the determination of the individual principal stresses in two-dimensional problems is described.

The method is based on the combined use of three retardation fringe patterns — a standard isochromatic pattern and two perpendicular scattered light patterns. A.

531.25 : 535.55

5092. AN OPTICAL METHOD OF DETERMINATION OF AVERAGES OF STRESSED STATES IN FINE-GRAIN POLYCRYSTALS. I-III. R.A.Zhitnikov and A.V.Stepanov.
Zh. tekh. Fiz., Vol. 26, No. 4, 772-8, 779-85, 786-94 (1956). In Russian.

531.259.2

5093. A STUDY OF THERMAL STRESSES IN CYLINDERS. A.Kelen and W.Romberg.
Arch. Math. Naturvid., Vol. 53, Paper 3, 45 pp. (1956). In German.

Formulae are developed, involving Bessel functions, for the temperature distribution in a cylinder. Then the stress equations are set up and solved. Some special cases are considered and numerical and graphical results are given. A table of stress values is given for transient stress in a number of materials, including metals and ceramics. L.S.Goddard

531.3

5094. ADIABATIC INVARIANT OF THE HARMONIC OSCILLATOR. R.M.Kulsrud.
Phys. Rev., Vol. 106, No. 2, 205-7 (April 15, 1957).

The problem of a vibrating harmonic oscillator whose frequency is changing in time is considered in the case where the frequency ω is initially constant, varies in an arbitrary fashion and becomes constant again. It is found that the relative change of the quantity, the energy divided by the frequency, in the final region from its value in the initial region is zero to as many orders in the rate of change of ω as ω has continuous derivatives. For the case where there is a break in the Nth derivative of ω the relative change is given to this order. A.

531.31 : 530.145

ON THE BASIC FORMULATION OF CLASSICAL AND QUANTUM THEORIES. See Abstr. 5078

531.56

5095. DYNAMICS OF A SPINNING ROCKET WITH VARYING INERTIA AND APPLIED MOMENT. K.Jarmolow.
J. appl. Phys., Vol. 28, No. 3, 308-13 (March, 1957).

The dynamic motion of a spinning rocket of varying moments of inertia under the influence of a varying torque is analysed. The varying moments of inertia result from the rapid expenditure of fuel. The varying torque is produced by a constant rocket thrust asymmetrically applied while the body centre of gravity location varies as the fuel burns. Aerodynamic forces are assumed negligible. The analysis is performed through the direct application of Euler's equations, which have a special applicability to this type of problem. The resulting motion is described in terms of Euler angles and resembles the motion of an ordinary top with nonsteady precession. The motion is compared to that of a body of fixed moments of inertia caused by a torque of fixed magnitude. It is shown that the variable aspects of the general problem create important characteristics of the resulting motion. A.

531.578

5096. DYNAMICS OF A PROJECTILE PENETRATING SAND. W.A.Allen, E.B.Mayfield and H.L.Morrison.
J. appl. Phys., Vol. 28, No. 3, 370-4 (March, 1957).

The experiment reported was designed to obtain data on the dynamics of a nonrotating, conical-nosed projectile penetrating randomly-packed sand. Position v. time measurements for the projectile in sand were obtained by means of a photographic-electronic chronograph developed for the purpose. The striking velocity v_0 of all rounds was about 700 m/sec. The negative acceleration of a 5 in. long, 0.50 calibre, 80 gramme projectile was found to be roughly expressible by the equation $-dv/dt = \alpha v^2 + \beta v + \gamma$ where the coefficients α, β, and γ are positive constants. This general relation includes as special cases the conventional penetration formulae of Robins–Euler, Poncelet, and Résal. A new theory of penetration is proposed based on the equations: $-dv/dt = \alpha v^2$, $v_0 > v > v_c$; $-dv/dt = \beta v^2 + \gamma$, $v_c > v > 0$ where the coefficients α, β, γ are positive constants and $\alpha < \beta$. An abrupt transition in the drag force that occurs at the critical velocity v_c of about 100 m/sec is believed due to transition from inelastic to quasi-elastic impact. A.

MECHANICAL MEASUREMENTS 531.7

531.719.2

5097. PRECISION OF THE GEODIMETER AS AFFECTED BY THE SPEED OF LIGHT IN AIR. D.T.Williams and J.R.Williams.
Rev. sci. Instrum., Vol. 28, No. 2, 108-15 (Feb., 1957).

The Geodimeter (Abstr. 6337/1950) has been analysed as to limitations on its precision in range measurement imposed by uncertainties in the velocity of propagation of light in the atmosphere. The instrument has been found elsewhere to be somewhat more consistent that the best current value of the velocity of light in vacuo, that is, to about one part in 3 million. On the basis of the analysis reported here, routine measurements to one part in 10^6 are concluded to be warranted, as far as propagational errors are concerned, up to ranges of about 100 km. Higher precisions, up to 1 in 10^7, are concluded to be attainable. A

MECHANICS OF FLUIDS 532

532.1

5098. BERNOULLI'S PRINCIPLE AND ATMOSPHERIC PRESSURE. J.S.Miller.
Amer. J. Phys., Vol. 25, No. 1, 42-3 (Jan. 1957).

An apparatus for the demonstration of atmospheric pressure is described. It is based on Bernoulli's principle, and consists of a tin can attached by a one-hole stopper to a T-tube through which a rapid stream of air is passed. The T-tube must be constricted at the junction region, or, alternatively, a tube of smaller diameter and bore may be inserted into the horizontal arm so that its open end is just over the far shoulder of the T. H.H.Hodgso

532.122 : 534.222.

5099. DYNAMIC COMPRESSION OF LIQUIDS FROM MEASUREMENTS ON STRONG SHOCK WAVES. J.M.Walsh and M.H.Rice.
J. chem. Phys., Vol. 26, No. 4, 815-23 (April, 1957).

High explosives were used to drive strong shock waves into various liquids, and a moving-image camera was employed to determine velocities associated with the shock waves. The measured velocities are transformed to pressure–compression points by applying the conservation relations. The pressures attained vary among the 15 liquids studied but are typically in the range 50 kilobars to 150 kilobars. For water, more extensive experimentation sufficed to determined the Hugoniot curve from 30 kilobars to 450 kilobars. The highest pressure for each of the liquids extends the available data range from static experimentation several fold. A shock-wave reflection experimental method is described, the purpose of which is to measure the useful thermodynamic variable $(\Delta H/\Delta V)p$ at high pressures. Results are given for water. Qualitative experiments to study the transparency of shocked water, carbon tetrachloride, ethyl alcohol, and benzene are reported. A

532.123.08 : 539.32.08 : 534.21

ACOUSTICAL MEASUREMENT OF ELASTIC PROPERTIES OF LIQUIDS. See Abstr. 4053

532.13 : 532.517

5100. VISCOSITY AND ACTION. T.V.Starkey.
Brit. J. appl. Phys., Vol. 7, No. 12, 448-50 (Dec., 1956).

Hamilton's principle is used to show that for the laminar flow of a given volume of liquid through a tube the product of the energy dissipated and the time is a minimum. This condition requires a parabolic velocity distribution in liminar flow through tubes. It is also shown that the non-turbulent flow of a fluid showing shear dependence is not laminar, and that it resembles in many fundamental respects the turbulent flow of a Newtonian liquid. These results follow from the recognition of apparent viscosity as a direct measure of the action per unit volume associated with a given change in the configuration of the elements of which the fluid may be imagined to consist.

532.13 : 536.

HYDRODYNAMICS OF OSCILLATING DISKS IN VISCOUS FLUIDS. See Abstr. 4282

532.13.08

5101. MICROSCOPIC METHOD OF STUDYING ANOMALOUS VISCOSITIES. U.Ghosh.
Sci. and Culture, Vol. 22, No. 3, 172-3 (Sept., 1956).

Flow of a glycerol solution containing graphite and an aqueous solution of carboxymethyl cellulose through a capillary tube of circular cross-section have been studied. The velocity distribution across the tube of the suspended particles have been observed by a microscope. The results are shown graphically. H.G.Jerrard

532.137 : 621.317.39

5102. AN ELECTROMAGNETIC VIBRATING VISCOMETER. I.Kimura and H.Fuwa.
Bull. Electrotech. Lab. (Tokyo), Vol. 20, No. 11, 831-9 (Nov., 1956). In Japanese.

A method of continuous measurement of viscosity is described. The transducer has a vibrating plate or cylinder which is driven by a constant driving force. The mechanical impedance due to the retarding force against the motion of the plate or cylinder immersed in the liquid and corresponding to the viscoelasticity G and density ρ, is measured electromagnetically. Some results of calculation of the retarding force on the plate and cylinder surfaces are described. Various types of model have been designed for operation within pipe lines or tanks, and for rapid testing of samples. This method is capable of continuous measurement of viscosities of liquids in any process in an industrial plant. A.

532.517 : 534.21

SMALL-SCALE ACOUSTIC STREAMING IN LIQUIDS. See Abstr. 4052

532.593

5103. APPROXIMATE LAWS RELATING TO THE GERTSNER BILLOW OF FINITE DEPTH. J.Kravtchenko and A.Daubert.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2006-9 (Dec. 17, 1956). In French.

Directs attention to the practical significance of the existence theorem, relating to a Gertsner billow propagated in a fluid of constant finite depth, more especially, as regards the motion of wavelength in relation to the distribution of turbulence in the billow; formulae are derived, accurate so far as the fourth order of the amplitude of the swell, giving the contour wavelength and acceleration of a Gertsner billow of finite depth. J.S.G.Thomas

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 537.531

5104. THE LIMITING VALUE, FOR VERY SMALL ANGLES, OF THE OBSERVABLE INTENSITY OF X-RAYS SCATTERED BY FLUIDS. G.Fournet.
J. Phys. Radium, Vol. 17, No. 11, 940-3 (Nov., 1956). In French.

There are several conflicting expressions for the limit of the intensity as $\theta \to 0$. The author defines the "observable" intensity as that part of the intensity which is proportional to the number of molecules irradiated. It is shown, by considering a statistical model of a fluid, that the uncertainty as to the correct expression for the complementary intensity can be of the same order as the "observable" intensity. A.R.Stokes

532.7 : 534.23

ON THE PRESSURE DEPENDENCE OF SOUND ABSORPTION IN LIQUIDS. See Abstr. 4066

532.731 : 532.62

5105. AIR BUBBLES IN WATER. L.Liebermann.
J. appl. Phys., Vol. 28, No. 2, 205-11 (Feb., 1957).

The solubility of air bubbles is observed in a variety of experiments. Freely rising bubbles exhibit a solution rate more than twice that of bubbles which are stationary: i.e., trapped on the walls of the container. The theory of solution of stationary bubbles is given but the theory of a free bubble is difficult and has not been solved. Stationary bubble observations lead to a determination of the coefficient of diffusivity: 2.9×10^{-5} cm^2/sec at 27°C; the temperature dependence is considerable, obeying Einstein's equation relating diffusion and viscosity. The effect of surface contamination on diffusion is analysed; bubble solution in the presence of contaminants is not greatly altered. Experiments are described showing that air bubbles of dimension less than 1μ lodged on hydrophobic particles are not soluble and can exist indefinitely. It is shown that hydrophobic particle residues frequently remain after bubble solution, even in relatively pure water. These residues function as bubble nuclei for boiling or for cavitation. A.

532.739.2

5106. SOLUBILITY OF HYDROGEN AND DEUTERIUM IN NONPOLAR SOLVENTS. M.W.Cook, D.N.Hanson and B.J.Alder.
J. chem. Phys., Vol. 26, No. 4, 748-51 (April, 1957).

Data are presented for the solubility of hydrogen and deuterium in eight nonpolar solvents from −25° C to 35° C, and show that deuterium is about 2.5% more soluble. The data are accurate to 0.1% and correlate successfully with the solubility parameter of the solvent. The various thermodynamic functions are calculated. A.

532.77 : 532.5 : 541.64

5107. ON THE THEORY OF HYDRODYNAMIC PROPERTIES OF SOLUTIONS OF MACROMOLECULAR CHAINS. R.Cerf.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 1875-7 (Dec. 5, 1956). In French.

A general theory is obtained by introducing an internal viscosity into a model based on the concept of the submolecule (Abstr. 3476/1955). The coefficient of friction is now re-defined with respect to the normal coordinates of the molecule, and leads to a more rigorous theory with new applications for the case of flexible molecules. The theory is applied to flow birefringence and to non-Newtonian viscosity. G.Allen

532.77 : 532.17 : 541.64

5108. ON THE NON-NEWTONIAN VISCOSITY OF SOLUTIONS OF MACROMOLECULAR CHAINS. R.Cerf.
C.R. Acad. Sci. (Paris), Vol. 244, No. 4, 456-9 (Jan. 21, 1957). In French.

An extension of the preceding abstract. Equations for the dependence of the intrinsic viscosity $[\eta]$ on the flow gradient (G) are obtained. Two limiting cases are considered where the internal viscosity of the polymer is (a) large and (b) small compared with the viscosity of the solvent. Case (a) approximates to that for rigid particles and an expression for $[\eta]/[\eta]_0$ as a function of $M[\eta]_0 G$ is obtained. Flexible molecules approximate to case (b) and $[\eta]-[\eta]_0$ is a function of $M[\eta]_0 G$. Analysis of experimental results for polyisoprene in benzene indicates that polyisoprene is a flexible molecule. This seems to be a good criterion of flexibility. G.Allen

532.77

5109. POTENTIOMETRIC TITRATION, ASSOCIATION PHENOMENA, AND INTERACTION OF NEIGHBORING GROUPS IN POLYELECTROLYTES. S.Lifson.
J. chem. Phys., Vol. 26, No. 4, 727-34 (April, 1957).

The partition functions and potentiometric titration equations are calculated for a number of types of polyelectrolytes, including polyampholytes and other electrolytic copolymers. The effects of the interaction between neighbouring groups and of the electrostatic potential of the macromolecule as a whole are both accounted for independently, by treating the ionized macromolecule as a separate phase in equilibrium with the surrounding solution. The possibility of association of monovalent cations with the acidic groups of polyacids is discussed, following the derivation of the titration equations for both the H^+ ion and the associating metallic cation. A.

532.77

5110. MAYER'S TREATMENT OF IONIC SOLUTIONS. E.Meeron.
J. chem. Phys., Vol. 26, No. 4, 804-6 (April,1957).

Mayer's expressions for the ionic activity coefficient and osmotic pressure of an electrolyte solution are shown to involve known and accurately tabulated functions. Mayer's infinite series of integrals is summed to give a single integral involving the Debye—Huckel potential of average force. With the help of the new form, the use of the single cut-off parameter for binary electrolytes is discussed from a quantitative standpoint. A.

532.77

5111. DIFFUSION WAVES AND OSMOTIC PRESSURE. R.Lucas.
J. Phys. Radium, Vol. 17, No. 11, 913-22 (Nov., 1956). In French.

The thermal motion of molecules of a solute can be treated by reference to a "wave of diffusion". Such waves, characterized by a phase velocity and a group velocity, can be expressed in the coefficient of diffusion; and the osmotic pressure can be expressed as the radiation pressure of the wave of diffusion. The idea is worked out in some quantitative detail. S.J.Gregg

532.77

5112. QUADRUPOLE RELAXATION AND LINE WIDTH IN NUCLEAR MAGNETIC RESONANCE IN COMPRESSED LIQUIDS. J.Seiden.
J. Phys. Radium, Vol. 17, No. 12, 1018-19 (Dec., 1956). In French.

532.783

5113. QUADRUPOLE RESONANCE IN LIQUIDS. J.Seiden.
J. Phys. Radium, Vol. 17, No. 10, 876-86 (Oct., 1956). In French.

In mobile liquids with isotropic motions no quadrupole resonance spectrum is possible. But anisotropic motion, as in liquid crystals, can lead to resonance at lower frequencies than in the crystal and in highly viscous media resonance is also possible. These cases are discussed in detail theoretically. It is concluded that the lines are so broadened that they will be difficult to observe above noise. D.H.Whiffen

MECHANICS OF GASES 533

533.15

5114. THE TIME LAG IN DIFFUSION. H.L.Frisch.
J. phys. Chem., Vol. 61, No. 1, 93-5 (Jan., 1957).

Explicit expressions for the time lag in linear diffusion of a gas or vapour through a membrane with concentration-dependent diffusion coefficient are obtained without explicitly solving the diffusion equations. Generalizations of the method used to obtain the time lag are indicated. The use of the derived relations is sketched by applying them to several cases of physical interest. A.

533.5

5115. SOME NEWS FROM THE FIELD OF VACUUM TECHNOLOGY IN CZECHOSLOVAKIA. P.Hix.
Slaboproudý Obzor, Vol. 17, No. 12, 727-35 (1956). In Czech.

Gives a fairly detailed description (with photographs, drawings, diagrams and operating characteristics) of the following items: (1) fractionating oil diffusion pumps operating with a fore vacuum of 0.5 mm Hg and producing a final vacuum of 5×10^{-7} mm Hg; pumping speeds of these devices range from 10 to 1200 litres per sec; (2) high vacuum valves; (3) a Penning gauge for vacua of down to 5×10^{-7} mm Hg; (4) an ionization gauge for vacua down to 10^{-6} mm Hg; (5) a leak detector based on a Pd tube; (6) the properties of some Czechoslovak diffusion-pump oils ("Atensols"), and (7) an instrument for measuring vapour pressure of the diffusion oils (tensimeter). R.S.Sidorowicz

533.6.011

5116. THE APPLICATION OF THE CENTRIPETAL EFFECT IN AIR TO THE DESIGN OF A PUMP. B.Popper and M.Reiner.
Brit. J. appl. Phys., Vol. 7, No. 12, 452-3 (Dec., 1956).

The centripetal second-order effect between parallel and coaxial rotating plates, known for very viscous and elastic liquids (Abstr. 1332/1947), was observed in air and used in designing a centripetal pump. Details of such a pump are given, which has been built to verify Maxwell's theory that air is an elastoviscous fluid with a relaxation time of 1.961×10^{-10} sec. J.M.Zarzycki

533.6.011

5117. STEADY UNIDIMENSIONAL FLOW PROPERTIES OF ANY GAS IN A BLAST PIPE (TUYÈRE), OF VARIABLE CROSS-SECTION OR NOT, WITH EXCHANGE OF HEAT AND DISSIPATION OF ENERGY DUE TO VISCOSITY. M.Wanner.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1485-7 (Nov. 12, 1956). In French.

From the equation of continuity, the energy equation and an expression for the second law of thermodynamics a general differential equation for the flow of a gas under the specified conditions is obtained. Some special cases, when additional limitations are imposed, are considered. F.E.Hoare

533.6.011.31

5118. ASYMPTOTIC BEHAVIOUR OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER OVER A CIRCULAR CYLINDER WITH UNIFORM SUCTION. M.Yasuhara.
J. Phys. Soc. Japan, Vol. 12, No. 1, 102 (Jan., 1957).

533.6.011.311

5119. BOUNDARY LAYER GROWTH ON A FLAT PLATE WITH SUCTION OR INJECTION. H.Hasimoto.
J. Phys. Soc. Japan, Vol. 12, No. 1, 68-72 (Jan., 1957).

Exact solutions of the Navier–Stokes equations are obtained for the boundary layer growth on an infinite flat plate with uniform suction or injection (with velocity V normal to its plane) which is started at time t = 0 (with velocity U along its plane), for the two cases: (i) U = arbitrary, V = constant and (ii) $U \propto t^{\alpha}$, $V \propto t^{-1/2}$. The case (i) gives simple relations between the cases of suction and injection and (ii) gives similar velocity profiles. Rayleigh's problem (U = const.) is investigated in detail, and the resulting solutions show the same qualitative natures as the corresponding steady-flow solutions for a semi-infinite flat plate. A

533.6.011.311 : 534.2

NOISE TRANSMISSION FROM BOUNDARY LAYER PRESSURE FLUCTUATIONS. See Abstr. 4049

533.6.011.3

5120. ENTROPY CHANGES IN RAREFACTION WAVES. R.F.Dressler.
J. Res. Nat. Bur. Stand., Vol. 57, No. 5, 265-71 (Nov., 1956).

Frictional flow of a polytropic gas is investigated for centred rarefaction waves. Energy balance is maintained by assuming that mechanical energy loss due to frictional force reappears as heat. Entropy behaviour at the wave-front is discussed. The nonhomogeneous linear system of partial differential equations with variable coefficients for first-order frictional effects is derived. Utilizing the geometrical similarity of the Mach lines, the functional form of these quantities is ascertained, which permits explicit solutions of the boundary value problem. The expansion procedure is singular at the wave front, and results are not applicable there. First-order effects are expressed as polynomials plus terms singular at the wave-front. Results are compared with expressions obtained when heat generation due to frictional force is neglected. A

533.6.011

5121. A METHOD OF MAKING SUPERSONIC FLOWS VISIBLE IN A BLAST. G.Dubois.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2009-12 (Dec. 17, 1956). In French.

Mach waves and lines of flow in a supersonic blast can be made visible by a stirioscopic technique which is described and illustrated. Thin nylon or hair filaments are used. J.S.G.Thoma

VIBRATIONS. ACOUSTICS 534

534.1

5122. VIBRATIONS OF AN END-LOADED STRIP. H.S.C.Chen.
Brit. J. appl. Phys., Vol. 7, No. 12, 450-1 (Dec., 1956).

The problem of an end-loaded strip, vibrating in a vertical plane, has been solved under the usual condition that the mass of the strip is neglected. The deflection curve is derived first from statical considerations. Frequency is then calculated on the basis of energy relations. Agreement with experiments of Hearmon and Adams seems to be better than previous results.

534.1

5123. SIMPLE MODES OF VIBRATION OF CRYSTALS. R.D.Mindlin.
J. appl. Phys., Vol. 27, No. 12, 1462-6 (Dec., 1956).

In this paper there are described solutions of the three-dimensional equations of elasticity and the equations of generalized plane stress pertaining to vibrations of crystal rectangular parallelepipeds and thin plates with traction-free faces. The modes of motion exist in crystals of certain classes for specific orientations and length-ratios of the edges. Since the solutions are exact and in closed form they may be used to advantage in connection with the measurement of elastic constants. Special disposition of electrodes is required for piezoelectric excitation.

534.2 : 539.3

5124. ON THE PROPAGATION OF WAVES IN A VISCOELASTIC MEDIUM. A.Sentis.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 558-60 (Jan. 28, 1957). In French.

The velocities of irrotational and of equivoluminal stress waves in the idealized type of viscoelastic solid described in Abstr. 1655 (1956) are calculated. They depend on the frequency, and hence on the initial conditions of the wave motion. J.G.Oldroyd

534.213

5125. PROPAGATION OF A PLANE ACOUSTIC WAVE IN AN INFINITE PIEZOELECTRIC CRYSTAL. Y.Le Corre.
J. Phys. Radium, Vol. 17, No. 12, 1020-1 (Dec., 1956). In French.

Theoretical eppressions are derived for the velocity of propagation of waves in different directions in crystals of ADP and $BaTiO_3$. Certain differences in the results obtained by the classical theory and by that of Laval emerge from the calculations as well as some discrepancies between the expected and the observed characteristics of these crystals. H.J.H.Starks

534.22

5126. LINEAR DISSIPATION IN SOLIDS. C.Lomnitz.
J. appl. Phys., Vol. 28, No. 2, 201-5 (Feb., 1957).

In solid materials the properties of transient creep, internal friction and dispersion can be correlated on the basis of a linear theory, if the strains are small throughout. The theory, first given by Boltzmann, is developed in some detail. Dissipative properties of the material are shown to depend on a function of time called the "creep function" $\varphi(t)$. The general condition $1/Q \cong$ constant is examined. This condition is compatible with a creep function of logarithmic type. Velocity dispersion of plane or spherical waves is very small in such a medium. Graphs of $1/Q$, phase and group velocities v. frequency are given, and a quantitative relationship between creep and internal friction constants is derived. The results are substantially applicable to the problem of losses in dielectrics, by carrying out the electromechanical analogy. A.

534.22

5127. SOUND DISPERSION IN HALO-METHANE MIXTURES. R.Amme and S.Legvold.
J. chem. Phys., Vol. 26, No. 3, 514-17 (March, 1957).

Results of studies of the dispersion of ultrasound in mixtures of $CHClF_2$ in CF_4 and of $CHCl_2F$ in $CClF_3$ at various concentrations are presented. In none of the eight mixtures studied is there evidence of multiple dispersion; each mixture exhibited a single relaxation time which falls between the relaxation times of the pure constituents. A simple method of averaging the various quantities entering into the prediction of collision lifetimes in the pure constituents is presented which yields lifetimes for the mixtures nearly matching those found by experiment. A.

534.22 : 532.7 : 533.7

5128. PHENOMENOLOGICAL THEORY OF THE MOLECULAR ABSORPTION AND DISPERSION OF SOUND IN FLUIDS AND THE RELATION BETWEEN THE RELAXATION TIME OF THE INTERNAL ENERGY AND THE RELAXATION TIME OF THE INTERNAL SPECIFIC HEAT. O.Nomoto.
J. Phys. Soc. Japan, Vol. 12, No. 1, 85-99 (Jan., 1957).

Molecular absorption and dispersion formulae applicable to both liquids and gases have been derived in a phenomenological manner. It is pointed out that the relaxation time of the molecular internal energy τ must be distinguished from the relaxation time of the internal specific heat β and the relation between these two quantities is discussed in detail. The relaxation time τ has the advantage of making the dispersion formula simpler and directly comparable with the dispersion formulae in other cases, such as the relaxation of shear viscosity. The relaxation time β on the other hand, is more closely related to the collision excitation probability of the molecules than τ. A.

534.22 : 536.632

5129. RATIOS OF SPECIFIC HEAT AND HIGH-FREQUENCY VISCOSITIES IN ORGANIC LIQUIDS UNDER PRESSURE, DERIVED FROM ULTRASONIC PROPAGATION. E.G.Richardson and R.I.Tait.
Phil. Mag. (Eighth Ser.), Vol. 2, 441-54 (April, 1957).

Measurements of the velocity and attenuation of plane sound waves in a number of organic liquids at pressures up to 10 000 lb/in^2 have been made. From the velocity, the adiabatic compressibility is derived and from this, by comparison with the measured isothermal compressibility, the ratio of specific heats as a function of pressure is calculated. By introducing the measured attenuation into the Kirchloff formula an "ultrasonic" viscosity as a function of pressure is also derived. A.

534.22.08 : 532.7

5130. A NEW DIFFRACTION METHOD FOR MEASURING ULTRASONIC VELOCITIES IN LIQUIDS. M.Ramakrishna Raju and B.Ramachandra Rao.
Curr. Sci., Vol. 25, No. 12, 390-2 (Dec., 1956).

The method uses two identical progressive ultrasonic waves in a column of liquid, with parallel wavefronts. A light beam parallel to the wavefront shows variations in intensity as the phase difference between the two ultrasonic waves is continuously changed. If one of the ultrasonic gratings is moved along the direction of propagation, the intensity of diffracted light reaches maxima or minima at regular intervals of one wavelength, hence enabling the velocity to be determined for known frequency. The apparatus is described and specimen results given for aqueous solutions of NaCl. The method is only applicable for transparent liquids available in large quantities. G.F.Hodsman

534.222.2

5131. DETERMINATION OF THE VELOCITY FIELD BEHIND A DETACHED SHOCK WAVE. P.Guienne and F.Bouniol.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1479-82 (Nov. 12, 1956). In French.

It is considered that flow lines and Mach numbers characterizing the flow behind a detached shock wave, in the two-dimensional, supersonic flow of a perfect fluid, can be specified in terms of a single factor, namely, the specific mass, ρ, determined, e.g., by interferometry. The theory of the subject is developed, and illustrated by graphs derived from a practical interferometric example. The possible error is considered to be ± 0.015 in Mach number and $\pm 0.4^0$ in the direction of the velocity. J.S.G.Thomas

534.222.2

5132. GASEOUS DETONATIONS IN MIXTURES OF CYANOGEN AND OXYGEN. H.M.Peek and R.G.Thrap.
J. chem. Phys., Vol. 26, No. 4, 740-5 (April, 1957).

Precise experimental data are compared with precise theoretical values for the detonation velocities of several gaseous mixtures of cyanogen and oxygen. The results of this comparison show that these detonation processes are pathological in the sense of the theory of Kirkwood and Wood. Because of the lack of chemical kinetic data, it is not possible to calculate correct detonation velocities for these pathological detonations. Therefore, the determination of detonation velocities is not a worthwhile method for the determination of precise values of thermodynamic properties in mixtures of cyanogen and oxygen. A.

534.23 : 537.311.33

5133. ULTRASONIC ATTENUATION IN GERMANIUM AND SILICON. F.J.Blatt.
Phys. Rev., Vol. 105, No. 3, 1118-19 (Feb. 1, 1957).

Suggests an experimental procedure which may shed additional light on intervalley scattering and may permit a direct determination of the coupling constant for this process. W.Bardsley

534.23 : 537.312.62

5134. FURTHER ULTRASONIC EXPERIMENTS IN SUPERCONDUCTING POLYCRYSTALLINE TIN. L.Mackinnon.
Phys. Rev., Vol. 106, No. 1, 70-2 (April 1, 1957).

The effect of a longitudinal magnetic field on the sound absorption in a polycrystalline tin rod below and just above the superconducting transition has been studied. When the specimen is left with a frozen-in moment, the shape of the acoustic hysteresis loop is found to vary with change of path of the sound through the specimen. A reasonable qualitative explanation of this effect is given, but there is a shortage of information on other comparable phenomena in a rod of this shape and size; it does seem probable though that the core of the specimen remains largely normal in the intermediate state until an appreciable reverse field produces an escape of trapped flux. A.

534.23 : 534.26

5135. ATTENUATION AND SCATTERING OF ULTRASONIC WAVES IN A MEDIUM WITH SPHERICAL INHOMOGENEITIES. I.Malecki.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 3, 173-8 (1956).

Previous theoretical solutions of ultrasonic attenuation are extended to cover both solid and liquid media and the effect of reflections at, and mutual reactions of, inclusions. H.D.Parbrook

534.23 : 532.7

5136. EFFECTS OF PRESSURE ON ULTRASONIC RELAXATION IN LIQUIDS. T.A.Litovitz, E.H.Carnevale and P.A.Kendall.
J. chem. Phys., Vol. 26, No. 3, 465–C (March, 1957).

Measurements of sound absorption as a function of pressure in carbon disulphide and glycerol indicate that the relaxation effects causing the compressional losses in these liquids react differently to pressure changes. In CS_2 the relaxation frequency increased with increasing pressure. In glycerol the relaxation frequency dropped as the pressure was increased. These results are consistent with the view that different relaxation mechanisms exist in associated and nonassociated liquids. The direction of the pressure changes in each case is in accord with the view that thermal relaxation is the cause of compressional loss in nonassociated liquids and that

structural relaxation is the predominant factor in associated liquids. A detailed study of the thermal relaxation effects in CS_2 showed that the variations in relaxation frequency with pressure could not be adequately explained by Kittel's theory of thermal relaxation in liquids. Theoretical considerations of the relaxational part of the specific heat indicated that it should be only slightly pressure dependent. A.

534.23 : 532.7

5137. THEORY OF ULTRASONIC THERMAL RELAXATION TIMES IN LIQUIDS. T.A.Litovitz.
J. chem. Phys., Vol. 26, No. 3, 469-73 (March, 1957).

The theory of thermal relaxation phenomena in liquids is considered from the standpoint that the mechanism of energy transfer in the liquid is the same as in a gas. This would mean that binary collisions and not cooperative action of the molecules are important. The data on ultrasonic relaxation in CS_2 is considered. It is found that values predicted by use of the cell model, proposed for liquids and dense gases, in combination with binary collision theory give values for the pressure and temperature dependence of ultrasonic relaxation times which are in good agreement with experiment. Furthermore excellent agreement is found between the values of the probability of energy transfer per collision found in the liquid and gaseous CS_2. It also appears that the Schwarz—Herzfeld theory which has been applied to gases can also be applied to liquids and dense gases. It is concluded that the mechanism of energy transfer in thermal relaxation is not affected by the change in state from gas to liquid. A.

534.23.08 : 532.7

5138. MEASUREMENT OF ULTRASONIC WAVE ABSORPTION IN ETHYL ACETATE AT THE SATURATION LINE BY A PULSE METHOD WITH A DOUBLE FIXED DISTANCE. V.F.Nozdrev and V.D.Sobolev.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 4, 808-10 (1956). In Russian.

A new pulse method for the measurement of ultrasonic absorption has been described. This method was used for trial measurements of absorption in n-butyl alcohol within the range 0-90° C and in toluene within the range 20-270° C, and the results obtained are in good agreement with measurements accomplished by other methods. The measurements are carried out in a steel autoclave calculated to withstand pressures of several hundred atm and temperatures higher than 300° C. The ultrasonic absorption in ethyl acetate was measured at the saturation line at seven frequencies in the range 5 to 15 Mc/s. The dependence of the absorption on temperature and on frequency has been established. In ethyl acetate relaxation occurs in the temperature range 160-210° C and is retained up to the critical point. From the data obtained the relaxation time was calculated and it decreases from 2.65×10^{-8} to 2.12×10^{-8} sec when the temperature increases from 160° to 210° C. E.Rabkin

534.232

5139. GENERATION OF ULTRASONIC VIBRATIONS WITH FERRITES. U.Enz.
Dissert, E.T.H. Zürich, No. 2499, 53 pp. (1955). In German.

Equivalent circuits for magnetostrictive and electrostrictive ultrasonic resonators are established, the losses analysed and a formula derived for the radiation impedance of a ferrite diaphragm. Assuming a sound velocity of 5000 m/sec in ferrite materials, the quality factor of the resonator is calculated as 24, and the radiation in water as 1000 W/cm². The limiting factor is the mechanical strength of the ferrite rod. The author has come to the conclusion that the best material is NiZn ferrite with about 50% ZnO. Using this, the efficiency of the rod as an electroacoustical convertor can reach 94% at low powers, and is still 76% at 36 W. The sound intensity is limited to 6-8 W/cm², at which value the cavitation limit for water is exceeded. Mechanical stresses in the rod reach over 100 kg/cm². A number of ferrite rods (14 x 14 x 60 mm) were tried and they could all withstand 45 W drive power. Further increase of power can be achieved by introducing a steel rod which takes the tensile stresses off the ferrite and leaves it exposed only to the compression. An ultrasonic drill with a ferrite shank is described. J.M.Silberstein

534.24

5140. REFLECTION OF PLANE SOUND WAVES FROM A SINUSOIDAL SURFACE. J.G.Parker.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 377-80 (March, 1957).

The problem of calculating the specular component of the sound field reflected from a sinusoidal pressure release surface is discussed. The incident field is assumed to be plane and directed normally to the surface. Basically, the problem consists of obtaining the solution to a nonlinear differential equation derived in an earlier paper. This was done numerically and the results compared with existing experimental data on sound reflection from two differently formed surfaces. In one case agreement between calculated and measured values is quite good while in the second case there is considerable discrepancy. A possible explanation of this discrepancy is given. A.

534.24

5141. THE OBLIQUE REFLEXION OF SOUND PULSES. J.W.Craggs.
Proc. Roy. Soc. A, Vol. 237, 372-82 (Nov. 6, 1956).

It is observed that the classical theory of reflection of plane sound waves breaks down in the case in which a sound pulse is incident on a plane surface of separation of two media at an angle such that total reflection is to be expected. A sound wave is imagined to be generated by the supersonic motion of a thin wedge, and the motion when the wave meets the surface of separation is investigated by assuming dynamic similarity in the motion. It is shown that the solution of the problem is not of quasi-steady type, and that there is a diffused wave in the denser medium, with a wave front which preceeds the incident wave near the surface of separation. This wave is due to diffraction in the lighter medium round the edge of the incident wave. A further result is that there is still a reflected wave, and that its amplitude is equal in magnitude but opposite in sign to that of the incident pulse. A.

534.24 : 538.566

REFLECTION OF WAVES FROM AN ISOTROPIC INHOMOGENEOUS LAYER. See Abstr. 4564

534.2

5142. APPROXIMATE METHODS IN HIGH-FREQUENCY SCATTERING. D.S.Jones.
Proc. Roy. Soc. A, Vol. 239, 338-48 (March 12, 1957).

Two approximate methods for deriving the high-frequency scattering coefficient of two-dimensional obstacles without edges are described. In the first method a simple field which satisfies approximately the boundary condition near the points of glancing incidence is found. Elsewhere the geometrical acoustics field is used. The scattering coefficient is about 7% in error. In the second method Fourier transforms are employed to find a field which satisfies the boundary condition over a wider region. This leads to results which, for the circular cylinder, are in complete agreement with those of the exact theory. A

534.321.9 : 548.

ULTRASONIC MEASUREMENT OF NEUTRON DAMAGE IN SILICON. See Abstr. 4902

534.323 : 533.

5143. PRESSURE OF SOUND RADIATION ACCORDING TO THE KINETIC THEORY OF GASES. V.Gavreau.
J. Phys. Radium, Vol. 17, No. 10, 899-904 (Oct., 1956). In French.

After referring to Rayleigh's formulae for the pressure of sound radiation, the author shows that it is possible to deduce the same relationships between sound radiation pressure and energy-density (proportional to I/c — where I is the intensity of the sound and c the velocity of propagation) by a direct application of the kinetic theory of gases. This theory explains all the peculiarities of the phenomenon and gives an estimate of the value of the radiation pressure. It is shown experimentally that the coefficient of proportionality between radiation pressure and sound intensity is independent of the nature of the gas. A.B.Woo

534.3

5144. THE RELATIVE DISSIPATION OF ENERGY PER CYCLE OF DEFORMATION AT LOW FREQUENCY CONSIDERED AS A SPECIFIC PROPERTY OF MATTER. P.Le Rolland and E.Plenard
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1488-90 (Nov. 12, 1956). In French.

Vibration experiments with Plexiglas, which has a high damping capacity, show that the relative dissipation of energy per cycle k (= ΔW/W) is sensibly constant, irrespective of the amplitude and frequency of the vibration and of the dimensions of the test specimen. For materials such as brass, k tends towards a constant value (within about 10%) for small amplitudes of vibration. It is concluded that k can be used as a specific property of a material, subject to the limitation that, in metals, the amplitude of vibration is sufficiently small. H.J.H.Stark

534.3

5145. FREQUENCY RESPONSE OF SECOND-ORDER SYSTEMS WITH COMBINED COULOMB AND VISCOUS DAMPING. T.A.Perls and E.S.Sherrard.
J. Res. Nat. Bur. Stand., Vol. 57, No. 1, 45-65 (July, 1956).

Curves obtained with an analogue computer are presented for

the magnification factor v. frequency ratio of second-order mechanical vibrating systems with combined Coulomb (constant in magnitude) and viscous (proportional to velocity) damping. The ranges of the parameters are as follows: viscous damping ratio from 0.05 to 5.0, in 15 steps; Coulomb damping ratio from 0 to 0.9, in 11 steps; and frequency ratio from 0 to 2.0. Boundaries between regions with 0, 1, and 2 stops per half-cycle are also shown. A.

534.781

5146. ON PRESENTING THE OUTPUT OF A MECHANICAL SPEECH RECOGNIZER. D.B.Fry and P.Denes.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 364-7 (March, 1957).

The output of a mechanical speech recognizer consists of a series of units which are closely correlated with the phoneme sequence which forms the speech input to the system. This output has to be transformed and presented to the human "reader", usually in one of two ways, either by using it to reconstruct audible speech sequences or by presenting it in a sequence of visible characters. In both cases, the success of the recognizer will depend greatly on the degree to which good use can be made of the reader's existing linguistic knowledge, and methods of assessing its success must take this fact into account. The results are presented of experiments designed to compare methods of presenting the output and also methods of measuring the performance of the recognizer in terms of the ease with which the "reader" can reconstruct the input. A.

534.837

5147. SOME EXPERIMENTS RELATED TO THE NOISE FROM BOUNDARY LAYERS. H.H.Hubbard.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 331-4 (March, 1957).

Presents the main results of several recent experiments relating to the generation of noise in boundary layers. An attempt is made to correlate data obtained from a wind tunnel, a rotating disk, a helicopter rotor, and an aircraft in flight. These data provide evidence as to the mechanism of noise generation in the boundary layer and show how the noise varies as a function of velocity, density, and surface roughness. Some discussion is also given with regard to the relative importance of the boundary layer noise and the noise from the power plant in high-speed jet aircraft. A.

534.841

5148. PRACTICAL PRODUCTION AND USE OF MULTITONES. A.C.Raes.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 329-30 (March, 1957).

Advantages of multitones over warble tones and random noise are discussed. Three methods for producing multitones with simple apparatus and a tape recorder are described. Satisfactory decay curves have been obtained using only two components. A simple "duotone" generator, continuously adjustable over a single range from 80 to 3500 c/s is described. A.

534.844.1

5149. AN APPARATUS FOR THE MEASUREMENT OF REVERBERATION TIMES. G.Odin.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 3, 86-91 (Nov., 1956). In German.

An apparatus is described for the direct indication of reverberation times. The logarithmic damping recorder of the Breul and Ingard type is compared with the author's method in the measurement of reverberation times as a function of frequency in the range 70-3000 c/s, and shown to be in good agreement. A.B.Wood

534.845

5150. ABSORPTION OF SOUND BY PATCHES OF ABSORBENT MATERIALS. R.K.Cook.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 324-9 (March, 1957).

Circular patches, or long strips, of sound absorbent material are on the surface of an infinite perfectly reflecting plane. Exact solutions are found for the absorption of perpendicularly incident plane waves, and of randomly incident waves, on a circular piston-like absorber. An exact solution is found for the absorption of perpendicularly incident plane waves on an infinitely long strip-piston absorber. The basis of the technique is representation of the total wave-field by superposition of an incident plane-wave, a specularly reflected plane-wave, and a scattered wave. The last-named is in turn represented by a superposition of plane waves for the strip piston, and by a superposition of cylindrical waves for the circular piston absorber. The superposed wave-fields are adjusted to meet the boundary conditions. A.

534.846.6

5151. ELECTROACOUSTIC MEASUREMENTS IN MODEL ROOMS. W.Kraak.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 3, 91-8 (Nov., 1956). In German.

Discusses theoretically the propagation of sound in a loss-free medium, and then the effect of sound absorbing walls of a model room. With regard to the walls four special cases are considered (1) porous sound absorbers, (2) hollow resonators, (3) "plate" vibrators, and (4) the audience. The influence of air absorption is considered in relation of Knudsen's observations on the effect of humidity. The paper concludes with a discussion of methods of measurement for the range of frequencies covered in music and speech.

A.B.Wood

OPTICS. RADIATION. SPECTRA 535

535.12

5152. INTENSITY FLUCTUATIONS IN STATIONARY OPTICAL FIELDS. E.Wolf.
Phil. Mag. (Eighth Ser.), Vol. 2, 351-4 (March, 1957).

It is shown that the fluctuations in the instantaneous intensities at two arbitrary points in a stationary optical field are in general correlated and that this correlation is proportional to the square of the coherence function introduced into the theory of partially coherent fields by Blanc-Lapierre and Dumontet (Abstr. 4563/1955) and independently by Wolf (Abstr. 6051/1955). The result has a bearing on recent experiments by Hanbury Brown and Twiss (Abstr. 2009/1956) in which fluctuations in the current output from two photoelectric cells situated close to each other and illuminated by an almost coherent beam of light were found to be correlated. A.

535.214.4 : 523.6

5153. A NEW RADIOMETRIC EFFECT AND ITS APPLICATION TO COMETS. A.Dauvillier.
C.R. Acad. Sci. (Paris), Vol. 244, No. 2, 150-2 (Jan. 7, 1957). In French.

Experiments with dynamic radiometers show that, in addition to the well-known Crookes effect, other effects are present which are caused by thermic liberation of occluded gases from the material of the radiometer vanes. The results may offer an explanation of the apparent repulsive action of solar radiation shown by cometary tails from whose constituent dust particles, adsorbed gases and volatile compounds are driven out by the intense insolation.

D.R.Barber

535.247.4

5154. THE CORRECTION FOR THE INFLUENCE OF FINITE SLIT-WIDTH ON PHOTOMETER MEASUREMENTS. E.Zeitler.
Optik, Vol. 14, No. 1, 24-7 (Jan., 1957). In German.

A graphical method of correcting photographic density profiles recorded by a slit photometer for the effects of instrumental slit-width is outlined. D.R.Barber

535.32 : 535.13

5155. EFFECTS OF ATOMIC QUADRUPOLE MOMENTS UPON THE INDEX OF REFRACTION. R.A.Satten.
J. chem. Phys., Vol. 26, No. 4, 766-72 (April, 1957).

The effect of induced atomic quadrupole moments upon the refractive index is investigated using Maxwell's macroscopic field equations. For this purpose a new frequency-dependent parameter δ is introduced which is characteristic of a homogeneous isotropic dielectric and is proportional to what might be called the quadrupolarizability. In order to obtain a dispersion formula a quantum mechanical calculation is made of the induced electric and magnetic dipole and electric quadrupole moments. The results suggest the general form to use for the classical field quantities P, M, Q (electric and magnetic dipole and electric quadrupole moments per unit volume respectively) for the classical theory of crystal optics in a higher approximation. A.

535.321 : 535.323

5156. REFRACTIVE INDEXES OF SINGLE SYNTHETIC ZINC SULFIDE AND CADMIUM SULFIDE CRYSTALS. S.J.Czyzak, W.M.Baker, R.C.Crane and J.B.Howe.
J. Opt. Soc. Amer., Vol. 47, No. 3, 240-3 (March, 1957).

A new method has been devised for measuring refractive indexes of crystals in the visible and infrared region. In this method thermocouples with CaF_2 or KBr windows have been used to detect the chopped (10 c/s) refracted beam. Single synthetic crystals of CdS and ZnS grown by the vapour phase method have been examined from their absorption cutoffs to 1.4 μ. In comparing the results obtained, in the visible region, to the visual method of determining refractive indexes, the thermocouple detector method has duplicated these to

within an index of refraction of ±0.001. For data extended to the infrared region it is found that the calculated results compare very closely with the experimental data. Index of refraction measurements may now be extended considerably into the infrared region being limited only by the sensitivity of the detector and the intensity of the transmitted monochromatic beam. A.

535.321 : 535.323

5157. REFRACTIVE INDEX AND DISPERSION OF OPTICAL GLASSES IN THE NON-VISUAL SPECTRAL REGIONS. F.Reitmayer.
Optik, Vol. 13, No. 12, 544-59 (Dec., 1956). In German.

Two methods are described for determining the refractive indices of glasses for the Hg lines 3650 and 10 140 A. The mean of the results from the two methods is said to have mean errors of $\pm 11 \times 10^{-6}$ for the u.v. line and $\pm 4 \times 10^{-6}$ for the i.r. line. The results for a large number of Schott glasses are given. R.W.Fish

535.33 : 534.222.2

5158. SHOCK EXCITATION OF ATOMIC AND MOLECULAR SPECTRA. R.W.Nicholls and W.H.Parkinson.
J. chem. Phys., Vol. 26, No. 2, 423-4 (Feb., 1957).

Shock waves of Mach number from 4 to 8, giving temperatures up to 12 000°K, have been used to excite band and line spectra from powdered oxides of Mg, Al, Ca, Ti, Cr, Sr, Ba, W, and Fe, and powdered meteorite. J.Hawgood

535.33.03 : 537.523.5

5159. DETERMINATION OF LIMITING CONCENTRATIONS FOR SELF-ABSORPTION OF SPECTRUM LINES IN AN ARC DISCHARGE. V.S.Mel'chenko.
Optika i Spektrosk., Vol. 1, No. 3, 321-9 (1956). In Russian.

In industrial spectrum analysis the source of light is normally a discharge at atmospheric pressure. Unfortunately the line intensity is much reduced by self-absorption of the source itself. Further there is much difficulty in determining the absolute concentrations of radiating atoms in discharges at atmospheric pressure. The author has used the method suggested by Prilezhaeva (Trudy Sibirskogo Fiziko-Tekhnicheskogo Instituta, Vol. 28, 83, 1949) for a study of self-absorption, making measurements of the intensity of Na and determining their dependence upon concentration of emitting atoms found from supplementary data on volatility of elements. Results obtained experimentally are in accord with theoretical. C.R.S.Manders

535.33.07

5160. VACUUM SPECTROGRAPH AND CONCAVE GRATING IN NORMAL INCIDENCE FOR THE FAR ULTRAVIOLET. S.Robin and St.Robin.
J. Phys. Radium, Vol. 17, No. 11, 976 (Nov., 1956). In French.

The construction is described in outline. The grating has radius 1 metre with 1200 lines per mm, and the plate is 9 × 12 cm. G.F.Lothian

535.33.08

5161. WAVELENGTHS FROM IRON-HALIDE LAMPS. R.W.Stanley and W.F.Meggers.
J. Res. Nat. Bur. Stand., Vol. 58, No. 1, 41-9 (Jan., 1957).

The history of secondary standards of wavelength for spectroscopic measurements is briefly reviewed. The present system of international secondary standards is based on interferometer determinations of wavelengths emitted by an electric arc between iron electrodes at atmospheric pressure; their uncertainty is of the order of 1 part in 3 million. It is shown that iron lines obtained from an electrodeless lamp, containing a minute amount of iron bromide, permit higher accuracy of wavelength measurement. The wavelengths of 103 radiations from such a lamp have been measured with Fabry–Perot interferometers. They range from 2954.8031 to 4064.7414 A, and calculated probable errors, as well as atomic-energy intervals, indicate that the relative values are uncertain by only 1 part in 7 or 8 million. A.

535.331

5162. ISOTOPE SHIFT IN THE SPECTRUM OF MERCURY. F.McClung and J.R.Holmes.
J. Opt. Soc. Amer., Vol. 47, No. 4, 297-9 (April, 1957).

By using separated isotopes of Hg^{198} and Hg^{202}, in sealed discharge tubes, the isotope shift in several lines from 16 000 A to 4000 A has been measured with direct recording techniques. A grating crossed with a pressure tuned Fabry–Perot interferometer was coupled to electronic detectors to make a linear recording system. The detectors were a photomultiplier tube in the visible and a lead sulphide cell in the infrared. The output of the detector is amplified and then recorded on a strip chart recorder. By optical switching between the two discharge tubes during the recording both isotopes appear on the same record without overlapping of the intensity pattern. Because of the inherently high accuracy of this type of system the probable errors are small. A

535.331 : 535.337

5163. THE ZEEMAN EFFECT IN THE HYPERFINE STRUCTURE OF THE 4101 A INDIUM LINE ($5^2P_{1/2}$–$6S_{1/2}$). D.A.Jackson.
J. Phys. Radium, Vol. 17, No. 12, 977-87 (Dec., 1956). In French.

The line has been studied by a double etalon with multidielectric reflecting surfaces in a magnetic field of 5800–8500 gauss. Its width was reduced by use of absorption techniques and an atomic beam. A detailed discussion of the experimental arrangement is given. All results showed a general agreement in the distribution pattern of the π and σ components; this similarity would not be obtained if there were a complete Paschen–Back effect. The use of a selection rule that π and σ components must involve, in the upper and lower levels, no change in the quantum number m and a change of ±1 respectively, together with the Heisenberg and Jordan quantum theory of anomalous Zeeman effect gave an extremely satisfactory explanation of the experimental results. L.Bove

535.331 : 537.525.5

RESONANCE MULTIPLETS OF Al, Tl, Cr, Mn, Mo AND IONS OF Ba, Ca, Sr. See Abstr. 4414

535.33

5164. ON THE ORIGIN OF THE BAND SPECTRA OF CALCIUM AND STRONTIUM. L.Huldt and A.Lagerqvist.
Ark. Fys., Vol. 11, Paper 24, 347-56 (1956). In German.

Previous work (Abstr. 10053/1955) has been extended. High dispersion spectra were recorded of Sr and Ca in the acetylene flame, in the "vacuum arc" between carbon electrodes in saturated water vapour, and in air. To obtain evidence on the type of molecule responsible for the emission bands, H_2O and D_2O were added alternatively. Spectrograms are (poorly) reproduced and band edges tabulated for Sr in the 6100 and 6900 A regions, and Ca in the 6000–6300 A region. Isotope shifts were established for Sr with H_2O and D_2O, but not for Ca. Gaydon's work on Ca (Abstr. 8601/1955) is discussed and a resumé of previous work included. It is concluded that the emitting molecule is probably, but not certainly, SrOH (or SrOD). S.T.Henderson

535.33

5165. NEW SYSTEM OF EMISSION BANDS OF THE He_2 MOLECULE AT ABOUT 4700 cm^{-1}. G.Hepner and L.Herman.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1504-6 (Nov. 12, 1956). In French.

A new infrared emission band of He_2 at about 2.1 μ is reported and wave-numbers of rotational lines are given. It was excited in the positive column of a discharge through helium. The transition $b\Pi^3{}_g$–$a^3\Sigma_u$ has been assigned. R.W.Nicholls

535.333 : 551.521.33

5166. HERZBERG OXYGEN BANDS IN "AIR" AFTERGLOWS AND THE NIGHT AIRGLOW. C.A.Barth and J.Kaplan.
J. chem. Phys., Vol. 26, No. 3, 506-10 (March, 1957).

The ultraviolet $A^3\Sigma_u{}^+$–$X^3\Sigma_g{}^-$ oxygen bands have been observed in emission from greenish-white "air" afterglows containing 95-98% nitrogen and 2% to 5% oxygen. The afterglows were excited by an electrodeless r.f. oscillator and examined with a grating spectrograph having an f/2 camera and a dispersion of 30 A/mm. The mechanism of excitation of these bands in the afterglow may be either the reaction $N + O_3 \rightarrow NO + O_2$ or the reaction $N + NO_2 \rightarrow N_2 + O_2$. A comparison of the afterglow spectrogram with an ultraviolet nightglow spectrogram shows that bands arising from higher vibrational levels are more intense in the airglow than in the afterglow. Collisional de-excitation can account for the lower vibrational temperature in the laboratory. The atomic nitrogen–ozone reaction also may occur in the chemosphere between 60 and 90 km and may contribute to the excitation of the night airglow Herzberg bands. The atomic nitrogen at this level could come from daylight predissociation of NO and N_2 and from the twilight dissociative recombination of ionized NO.

535.333 : 539.1

5167. EMISSION AND TWO-BODY RECOMBINATION IN BROMINE. H.B.Palmer.
J. chem. Phys., Vol. 26, No. 3, 648-54 (March, 1957).

The visible emission from hot, partially dissociated bromine raised to temperatures as high as 2500°K by means of a shock wave has been studied as a function of wavelength and temperature. At

total pressures around 1 to 2 atm in a 1-in. shock tube, the emission is continuous. It is caused by two-body atom recombinations of two types, one involving two unexcited Br atoms and the other involving one excited atom and one unexcited atom. The first type yields excited Br_2 molecules in the states, $^3\pi_{1u}$ and $^1\pi_u$, while the latter type produces excited molecules in the $^3\pi_0{}^+{}_u$ state. Proof of these mechanisms comes through analysis of emission spectra in terms of the potential diagram of bromine and through photomultiplier observations of the emission intensity at specific wavelengths as it varies with temperature and Br atom concentration. Some information is obtained on the shapes of the excited state potentials in the high energy region and an assignment of the transitions responsible for visible absorption in bromine is recommended. A.

535.333

5168. ON THE MEAN LIFETIME OF ACTIVE NITROGEN. R.Audubert and G.Calmar.
C.R. Acad. Sci. (Paris), Vol. 244, No. 3, 349-51 (Jan. 14, 1957). In French.

Describes experiments on the effects of changes of pressure, of carrier gas, and of the state of the tube surface, on the apparent lifetime θ of N_2* (produced by thermolysis of N_3Ag at about 265°C and 10^{-3} cm Hg) measured by change of intensity of the u.v. emission spectrum. The pressure variation can be expressed as $1/\theta = 1/\tau + KP^2$ where K depends on the particular gas but the true lifetime τ does not. With a cleaned surface, τ = 40 sec, and there are five emission bands between 2000 and 2700 A, while with the surface saturated with Ag, τ = 16 sec, and there is only one band, at 2500 A. J.Hawgood

535.333

5169. SOME INFRARED BANDS OF THE MOLECULE SrO. A.Lagerqvist and L.E.Selin.
Ark. Fys., Vol. 11, Paper 22, 323-8 (1956). In German.

The A $^1\Sigma$–X' $^1\Sigma$ system of SrO observed in emission near 9600 cm^{-1} is analysed with a grating spectrometer. For the lower state $B_v = 0.33779 - 0.00204(v+\frac{1}{2})$; $D_v = [0.354 + 0.0024(v+\frac{1}{2}) - 0.002(v+\frac{1}{2})^2]\ 10^{-6}$ $\omega_e = 653.49$; $x_e\omega_e = 3.96$ cm^{-1}. A new system lying near 1100 A is also observed. D.H.Whiffen

535.337 : 537.228.5

5170. STARK EFFECTS IN LINE BROADENING. H.Margenau and M.B.Lewis.
Phys. Rev., Vol. 106, No. 2, 244-50 (April 15, 1957).

Earlier calculations, based on customary radiation theory, fail to yield a meaningful finite answer for the second-order Stark effect upon line broadening. The reason for this occurrence is found in the assumption that, at some definite time, the radiating atom as well as the perturbing electron is in a precise energy state. When the electron is represented in a suitable way by a wave packet a finite line-width results, and this answer agrees within reasonable limits with that of the classical impact theory provided certain enumerated conditions are satisfied. A.

535.338.4 : 539.132

5171. ON INTENSITY CALCULATIONS IN THE BAND SPECTRA OF DIATOMIC MOLECULES (FOR THE CASE OF THE HARMONIC OSCILLATOR). J.Ruamps.
C.R. Acad. Sci.(Paris), Vol. 243, No. 25, 2034-6 (Dec. 17, 1956). In French.

535.34.07

5172. A CRITICAL COMPARISON OF PHOTOGRAPHIC AND PHOTOELECTRIC METHODS AND APPARATUS IN ABSORPTION SPECTROSCOPY. G.Milazzo.
R.C. Ist. Super Sanità, Vol. 19, Pt 11, 966-77 (1956). In Italian.

A comparison is made between photoelectric and photographic apparatus and methods for absorption spectrophotometry in relation to the most usual purposes of such measurements, viz. analysis and structure research. The errors to be expected in the final result are briefly discussed, and a few considerations are set out to serve as a guide to the choice of the most suitable apparatus and methods for the intended purpose. A.

535.343

5173. MODIFICATIONS OF THE Cs ABSORPTION SPECTRUM DUE TO INTERATOMIC INTERACTIONS. O.Jefimenko and S-Y.Ch'en.
J. chem. Phys., Vol. 26, No. 4, 913-19 (April, 1957).

Absorption spectra of Cs in the presence of H_2, D_2, N_2, He, Ne, A, Kr, Xe, methane, ethane, propane, n-butane, n-pentane, n-hexane, n-heptane, n-octane, and benzene were investigated following a similar work with Rb. It was found that the spectra of all these mixtures of Cs and foreign gas exhibit diffuse bands in the neighbourhood of certain Cs atomic lines. Over one hundred such bands were identified, the positions of the bands were measured, and some of the regularities in the occurrence of the bands were determined. The results of this investigation in general were found to be in qualitative agreement with the statistical theory of pressure broadening of the atomic lines if both the attractive and the repulsive interatomic forces are taken into account. It is, however, not certain that the statistical theory is capable of explaining the observed phenomena in their entirety. A.

535.343 : 548.7

5174. SPECTRA OF HALOGEN SOLUTIONS AND V BANDS IN ALKALI HALIDES. H.N.Hersh.
Phys. Rev. Vol. 105, No. 4, 1410-11 (Feb. 15, 1957).

It is shown that the V_1 band corresponds to the absorption of the halogen molecule (in CCl_4); the V_2 and V_3 bands correspond to the absorption of the halogen (X) dissolved in an aqueous solution of the alkali halide and attributed to the ion X_2-X^-. G.F.Lothian

535.343 : 539.132

INFRARED INVESTIGATION OF ACETIC ACID AND ACETIC ACID-d VAPOURS. See Abstr. 4581

535.343

5175. EXTREME VACUUM ULTRAVIOLET ABSORPTION SPECTRA OF SILVER CHLORIDE AND SILVER BROMIDE FILMS. C.J.Koester and M.P.Givens.
Phys. Rev., Vol. 106, No. 2, 241-3 (April 15, 1957).

The absorption spectra of silver chloride and silver bromide films have been extended to shorter wavelengths than in previous studies, in order to locate the maxima and any associated structure and to find the magnitude of the absorption coefficient. Measurements in the region 800-1600 A were made by using a grazing-incidence vacuum spectrograph with a Lyman discharge tube as source. Overlapping of orders was avoided by using the noble gases as filters. Sample films of the order of 100 A thick were vacuum evaporated on to very thin (100-150 A) celluloid supports. The silver halide film thicknesses were measured by channelled spectra. Silver chloride shows its greatest absorption in the region 900-1200 A, with some structure. Silver bromide has a broad absorption maximum about 1500 A, with some structure at shorter wavelengths. With the films used, both compounds showed absorption coefficients at maxima of approximately 1.5×10^6 cm^{-1}. A.

535.343

5176. ABSOLUTE INTENSITIES FOR THE ULTRAVIOLET γ BANDS OF NO. D.Weber and S.S.Penner.
J. chem. Phys., Vol. 26, No. 4, 860-1 (April, 1957).

Absolute intensities have been measured for three of the bands. The corresponding electronic absorption oscillator strength is estimated to be 0.0024 ± 0.0004. A.

535.343

5177. ABSORPTION SPECTRUM OF CO IN THE VACUUM ULTRAVIOLET REGION. Y.Tanaka, A.S.Jursa and F.LeBlanc.
J. chem. Phys., Vol. 26, No. 4, 862-6 (April, 1957).

Using the continua of the rare gases and the hydrogen continuum as background, the absorption spectrum of CO was investigated in the region 1070-2500 A. Most of the intercombination bands expected in this region were observed, and the a-X', a'-X, and e-X bands were extended to v' = 5, 21, and 17, respectively. The d-X bands, observed for the first time, were extended to v' = 21, and the fourth positive bands were extended to v' = 20. A brief discussion on the dissociation energy of the molecule is presented. A.

535.343

5178. EFFECTS OF HIGH PRESSURE ON THE NEAR ULTRAVIOLET ABSORPTION SPECTRA OF BENZENE AND MONOSUBSTITUTED BENZENES. W.W.Robertson, S.E.Babb, Jr and F.A.Matsen.
J. chem. Phys., Vol. 26, No. 2, 367-9 (Feb., 1957).

The near ultraviolet absorption spectra of benzene and several monosubstituted benzenes have been obtained in the vapour phase with partial pressures of nitrogen to 550 atm and in hydrocarbon solution with pressures up to 5500 atm. The spectra broaden asymmetrically and shift to longer wavelengths under pressure. The wavelength varies linearly with dielectric constant, both in the vapour phase and in solution, $\Delta\lambda/\Delta K$ lying between 20 and 29 A. A rough correlation is found between $\Delta\lambda/\Delta K$ and the oscillator strength of the transition. A.

535.343

5179. EFFECT OF HYDROGEN BONDING ON THE NEAR ULTRAVIOLET ABSORPTION OF NAPHTHOL. S.Nagakura and M.Gouterman.
J. chem. Phys., Vol. 26, No. 4, 881-6 (April, 1957).

The effect of hydrogen bonding on spectra of α- and β-naphthol,

which were used as the proton donor, was studied. Triethylamine, ethyl ether, and nitromethane were employed as the proton acceptor. Absorption measurements were made with ternary solutions which contain small amounts of proton donor and acceptor in n-heptane. The results show that both L_a and L_b bands decrease gradually with the increasing concentration of proton acceptor and new bands, which are caused by the hydrogen bonded proton donor molecule, appear on the longer wavelength sides of original bands. Using this change of absorption spectrum, the equilibrium constant between proton donor and acceptor and wavelength shifts due to hydrogen bonding were evaluated. From the evaluated values of these two quantities, it was concluded that the proton accepting power decreases in the order of triethylamine $[N(C_2H_5)_3]$ > ethyl ether $[O(C_2H_5)_2]$ > nitromethane (H_3CNO_2). On the basis of this proton accepting ability, it was discussed that hydrogen bonding is not purely electrostatic in its origin but the charge transfer or delocalization mechanism contributes it to an important extent. A.

535.343

5180. STUDY OF THE 7620 AND 6880 A BANDS OF THE SPECTRUM OF PURE OXYGEN COMPRESSED UP TO 5000 kg/cm². J. Robin, M.Desmaret and E.Ubelmann.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1750-3 (Nov. 26, 1956). In French.

The variation with pressure and density ρ of the absorption coefficient ϵ for the 7620 ($^1\Delta - ^3\Sigma$) and the 6680 A ($^1\Sigma - ^3\Sigma$) bands of O_2 has been measured up to pressures of 5000 kg/cm². ϵ_{max} was found to be proportional to ρ^2, but the integrated absorption coefficient $\int \epsilon d\nu$ was not. Between −78 and +300° C no appreciable temperature dependence was observed. The results were compared with absorption by liquid oxygen. R.W.Nicholls

535.343

5181. THE ABSORPTION SPECTRA OF SINGLE CRYSTALS OF PURE AND PARTIALLY DECOMPOSED SILVER AZIDE. A.C.McLaren.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 147-50 (Jan., 1957).

A microspectrophotometer has been built to study small crystals of pure AgN_3 and of specimens partially decomposed by ultraviolet light and by heat. Polarized light and specified crystal orientations are used. Bands at 4750 and 4900 A in the thermally decomposed, and at 4000 A in the irradiated specimens are explained fairly well by applying Mie's theory of scattering to small silver particles. A.G.Gaydon

535.343 : 535.372

5182. CONCENTRATION DEPENDENCE ON THE ABSORPTION AND FLUORESCENCE SPECTRA OF MIXED CRYSTALS OF ANTHRACENE WITH PHENANTHRENE AT 77°K. J.W.Sidman.
J. Amer. Chem. Soc., Vol. 79, No. 2, 305-7 (Jan. 20, 1957).

The absorption and fluorescence spectra of anthracene have been studied at 77°K in mixed crystals with phenanthrene, using concentrations of anthracene ranging from 0.6 to 100%. The origins of the absorption and fluorescence transitions vary in different ways as a function of the concentration of anthracene in the mixed crystal. The mechanism of energy transfer and fluorescence is interpreted on the basis of trapped excitons. It is postulated that the driving force for formation of the trapped exciton state in the crystal is due to the interaction of an electronically excited anthracene molecule with an unexcited anthracene molecule in an attempt to form a dimer. A.

535.343

5183. SOME RESULTS ON THE INFRARED ABSORPTION SPECTRA OF MIXTURES OF COMPRESSED GASES. R.Coulon, L.Galatry and B.Vodar.
Cahiers de Phys., No. 71-72, 47-9 (July-Aug., 1956). In French.

A review of the spectra of compressed mixtures of polar (HCl, HF and CO) and nonpolar (A, He, H_2, O_2, N_2) gases. G.Allen

535.343

5184. INFRARED ABSORPTION SPECTRA AT ABOUT THE SIXTH OCTAVE, OBTAINED AT THE LABORATOIRE DE RECHERCHES PHYSIQUES À LA SORBONNE. J. Lecomte.
Cahiers de Phys., No. 73, 26-8 (Sept., 1956). In French.

Replacement of the divisions, near, middle and far infrared by a number of octaves of specific ranges has been previously proposed by the author. Work on the correlation of infrared absorption data with molecular structure is generally described for the sixth octave, which covers the range 20-50 μ. G.I.W.Llewelyn

535.343

5185. APPARENT ABSORPTION AND REAL ABSORPTION IN THE VIBRATION–ROTATION SPECTRA OF GASES. J.Vincent.
Cahiers de Phys., No. 73, 28-31 (Sept., 1956). In French.

Observed spectra of methane and CO are given and discussed. G.I.W.Llewelyn

535.343 : 535.375.5

5186. INFRARED AND RAMAN SPECTRA OF VANADIUM OXYTRICHLORIDE. F.A.Miller and L.R.Cousins.
J. chem. Phys., Vol. 26, No. 2, 329-31 (Feb., 1957).

The infrared and Raman frequencies of liquid $VOCl_3$ (of symmetry C_{3V}) have been measured. The a_1 fundamentals are 1035, 408, and 165 cm^{-1}; those of species e are 504, 249, and 129 cm^{-1}. Most of the fifteen remaining bands can be explained as combinations of these. A.

535.343 : 532.77

5187. INFRARED SPECTRA OF HDO IN WATER AND IONIC SOLUTIONS. R.D.Waldron.
J. chem. Phys., Vol. 26, No. 4, 809-14 (April, 1957).

The infrared spectra of HDO in water and saturated metal halide solutions were investigated to study the interactions between ions and solvent molecules and the nature of hydrogen bonding in aqueous systems. The fundamental and overtone bands of the OH and OD stretching vibrations are shifted to lower frequencies and the bending vibration shifts to higher frequencies as one passes from the gaseous to the liquid state. Similar shifts occur for the metal halide solutions, the magnitudes of which are sensitive to the anion species but relatively independent of the cations. The frequency shifts for ionic solutions increase in the order I^-, Cl^-, F^-, with the shift in ion-free water about equal to that for Cl^-. The data are analysed in terms of four probable nearest-neighbour configurations in these solutions. The vibrational anharmonicity of the OH stretching vibration in solution is nearly independent of the frequency shift and only slightly larger than the gas value. The dependence of frequency shift on the shortening of hydrogen bonds (volume contraction) and H-bond energy were studied and gave qualitative agreement with other systems previously investigated. A.

535.343

5188. INFRARED SPECTRUM OF SOLID NITROUS OXIDE. D.A.Dows.
J. chem. Phys., Vol. 26, No. 4, 745-7 (April, 1957).

The spectrum was obtained at 80°K. Several bands due to isotopic species are seen. In contrast with CO_2, no evidence is observed for splitting due to intermolecular coupling or for reflection peaks in the spectrum. Spectral features assigned to torsional lattice motions (with fundamentals at 80 and 91 cm^{-1}) and to translational lattice motions (as broadening of ν_3) are present. A.

535.343

5189. INFRARED SPECTRUM OF DINITROGEN TETROXIDE. R.N.Wiener and E.R.Nixon.
J. chem. Phys., Vol. 26, No. 4, 906-8 (April, 1957).

The infrared absorption spectra of polycrystalline films of N_2O_4 at −180° have been examined in the region from 3500 to 400 cm^{-1} and found to be entirely consistent with the reported X-ray crystal structure. Four of the five infrared active fundamentals have been observed and values for three of the infrared inactive fundamentals, in good agreement with reported Raman data, have been inferred from combination bands. Other combinations indicate at least two torsional lattice modes in the range of 18 to 30 cm^{-1}. Several isotopic frequencies were also identified in the spectrum of solid N_2O_4 containing about 34.5 atom % of N^{15}. A.

535.343 : 537.311.33

OPTICAL PROPERTIES OF TYPE IIb DIAMONDS. See Abstr. 4334

535.34

5190. DEHYDRATION OF ROCHELLE SALT STUDIED BY INFRARED SPECTROMETRY. M.P.Bernard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2036-8 (Dec. 17, 1956). In French.

Studies of the absorption spectra in the region 3600-700 cm^{-1} of samples of Rochelle salt at different degrees of dehydration, have been made at -180° C, to obtain information on the degrees of bonding of water molecules. R.C.Seymour

535.343

5191. EXPERIMENTAL STUDY OF THE INFRARED BAND OF THE VALENCY VIBRATION OF KETONIC CARBONYL. F.J.Taboury.
Cahiers de Phys., No. 73, 24-6 (Sept., 1956). In French.

The carbonyl band has been investigated for benzophenone

(1655 cm^{-1}), acetophenone (1683, 1687 cm^{-1}), cyclohexone (1710, 1715 cm^{-1}), and cyclopentanone (1733, 1741, 1749 cm^{-1}). Raman spectra results on cyclopentanone and cyclohexanone are compared with these infrared data. G.I.W.Llewelyn

535.343 : 536.7

5192. VIBRATIONAL SPECTRA, POTENTIAL CONSTANTS, AND CALCULATED THERMODYNAMIC PROPERTIES OF CIS- AND TRANS-BrHC=CHBr, AND CIS- AND TRANS-BrDC=CDBr. J.M.Dowling, P.G.Puranik, A.G.Meister and S.I.Miller.
J. chem. Phys., Vol. 26, No. 2, 233-40 (Feb., 1957).

Raman displacements for the liquid and infrared absorption wave-numbers for both liquid and gas, together with quantitative depolarization factors for the Raman lines and semiquantitative relative intensities for both Raman and infrared bands, have been obtained for cis- and trans-BrHC=CHBr and cis- and trans-BrDC=CDBr. Assignments, consistent with the selection rules, were made for the four molecules. As a further check on the assignments a normal coordinate treatment (Wilson FG matrix method) was carried out. The heat content, free energy, entropy, and heat capacity for each of the molecules were calculated for 12 temperatures from 100 to 1000° K for the ideal gaseous state at 1 atm pressure. Finally the energy difference between the cis- and trans-isomers of $C_2H_2Br_2$ has been calculated. A.

535.343

5193. INFRARED ABSORPTION SPECTRA OF UREA, THIOUREA, AND SOME THIOUREA-ALKALI HALIDE COMPLEXES. J.E.Stewart.
J. chem. Phys., Vol. 26, No. 2, 248-54 (Feb., 1957).

The infrared absorption spectra of urea, thiourea, and thiourea complexes with caesium bromide, potassium iodide, potassium bromide, sodium bromide, and sodium iodide have been observed from 2 to 40 μ, except for the sodium iodide complex which was studied between 2 and 15 μ. The vibrations of urea and thiourea are assigned on the basis of a planar C_{2v} structure. A.

535.343

5194. SPECTRA OF UREA AND THIOUREA IN THE 3 μ REGION. R.M.Badger and R.D.Waldron.
J. chem. Phys., Vol. 26, No. 2, 255-6 (Feb., 1957).

Observations are reported on the polarized infrared spectra of single crystals of urea and thiourea in the 3 μ region. Complex structures accompanying the N–H fundamentals appear, at least in considerable part, to be attributable to combinations and overtones of fundamentals in the neighbourhood of 1650 cm^{-1}. A.

535.343

5195. VIBRATIONAL SPECTRA OF HEXAFLUOROBUTADIENE-1,3. J.C.Albright and J.R.Nielsen.
J. chem. Phys., Vol. 26, No. 2, 370-5 (Feb., 1957).

The infrared absorption spectrum of gaseous $CF_2 : CF–CF : CF_2$ has been obtained with a double-pass spectrometer equipped with prisms of LiF, NaCl, and CsBr. The Raman spectrum of the compound in the liquid state, at 20° C and −120° C, was photographed with a 3-prism spectrograph of linear dispersion 15 A/mm at 4358 A. Polarization ratios were measured for the stronger bands. Weakly exposed Raman spectra were obtained of the compound in the gaseous state at room temperature and in the crystalline state at −160° C. The spectral data are inconsistent with the assumption of the molecular symmetry C_{2h} (trans-form), but can be interpreted satisfactorily on the basis of symmetry C_{2v} (cis-form). However, the data do not exclude the possibilities that the molecular symmetry is C_2 or that the compound consists of a mixture of molecules of different symmetries. All of the 24 fundamental vibration frequencies have been assigned, and the spectra have been interpreted in detail. Some peculiarities in the spectra and some uncertainties in their interpretation are pointed out. A.

535.343

5196. VIBRATIONAL SPECTRUM OF N-METHYL FORMAMIDE. D.E.DeGraaf and G.B.B.M.Sutherland.
J. chem. Phys., Vol. 26, No. 3, 716-17 (March, 1957).

Infrared spectra of NMF and of NDNMF (N-deutero N-methylformamide) have been observed in the region 320-3600 cm^{-1}, as well as polarized Raman spectra in the range 225-3600 cm^{-1}. Assuming a trans-model with a plane of symmetry for NMF, it was possible to assign observed bands to all its 21 normal vibrations. J.Jacobs

535.343 : 535.375.5

5197. INFRARED AND RAMAN SPECTRA OF TRANS-DIFLUORODICHLOROETHYLENE. D.E.Mann and E.K.Plyler.
J. chem. Phys., Vol. 26, No. 4, 773-9 (April, 1957).

The spectra of t-$C_2F_2Cl_2$ have been measured and an assignment of fundamentals made. They are, in cm^{-1}: 1707, 1186, 632, 524, and 288 in a_g; 333 and 140 in a_u; 529 in b_g; and 1190, 892, 426, and 175 in b_u. A table of thermodynamic functions is given for the molecule in the ideal gaseous state. A.

535.343

5198. INFRARED SPECTRA OF KETENE AND DEUTEROKETENES. W.F.Arendale and W.H.Fletcher.
J. chem. Phys., Vol. 26, No. 4, 793-7 (April, 1957).

The infrared spectrum of di-deuteroketene is reported along with a number of fundamentals which were observed for CHDCO. The spectrum of CH_2CO has been re-examined and many new overtones have been assigned. A normal coordinate analysis tends to confirm the assignments through a successful calculation of the observed frequencies for CHDCO. A.

535.343

5199. INFRARED SPECTRUM OF ACETYLENE. H.C.Allen, Jr, E.D.Tidwell and E.K.Plyler.
J. Res. Nat. Bur. Stand., Vol. 57, No. 4, 213-15 (Oct., 1956).

The spectrum of acetylene has been observed and measured under high resolution from 1900 to 8500 cm^{-1}. Many of the bands observed have been analysed and precise values obtained for ν_0 and B'-B''. A good value of B_0 (1.176 84 ± 0.000 16) has been obtained by combining the results of the present work with previous data in the photographic infrared. The vibrational-energy problem is discussed. A.

535.343 : 539.133

5200. INTENSITIES IN THE INFRA-RED SPECTRUM OF BENZENE. H.Spedding and D.H.Whiffen.
Proc. Roy. Soc. A, Vol. 238, 245-55 (Dec. 18, 1956).

The absolute intensities of the infrared active fundamental vibrations of benzene, monodeuterobenzene, and para-dideuterobenzene have been measured and interpreted in terms of the dipole moment derivatives: $\partial\mu_z/\partial S_{11} = -1.43$ D/A; $\partial\mu_y/\partial S_{18a} = -0.51$ D/A; $\partial\mu_y/\partial S_{19a} = -0.32$ D/A; $\partial\mu_y/\partial S_{20a} = -0.78$ D/A. All three spectra are consistent with these values. The "effective" C–H bond moment for in-plane bending is 0.31 D and for out-of-plane bending 0.61 D. The value for the C–H bond-stretching dipole-moment derivative is 0.45 D/A with the H atom becoming less positive as the bond stretches. In-plane distortions of the carbon skeleton which leave the C–H bond directions unchanged, produce zero dipole moment within the experimental error. A.

535.343 : 539.133

5201. MICROWAVE SPECTRUM AND STRUCTURE OF SULFURYL FLUORIDE. D.R.Lide, Jr, Mann, D.E. and Fristrom, R.M.
J. chem. Phys., Vol. 26, No. 4, 734-9 (April, 1957).

The microwave spectrum of sulphuryl fluoride, SO_2F_2, has been reinvestigated. The spectra of the S^{32} and S^{34} species in natural abundance have been analysed, and the structure has been determined with the aid of the S^{34} isotope shift. The correction for zero-point vibration was shown to be small. The structural parameters are: $r_{SO} = 1.405 \pm 0.003$ A, $r_{SF} = 1.530 \pm 0.003$ A, $< OSO = 123°58' \pm \pm 12'$, and $< FSF = 96°7' \pm 10'$. The molecular dipole moment is 1.110 ± 0.015 Debye units. A number of satellite lines were observed and assigned to excited vibrational states. Some anomalies in the measured rotational constants for the excited states have been interpreted in terms of a Coriolis-type interaction between the fundamentals $\nu_4(A_1)$ and $\nu_5(A_2)$. From an analysis of this interaction the frequency of the hitherto unobserved $\nu_4(A_1)$ fundamental was found to be 388 ± 15 cm^{-1}. A.

535.343

5202. MICROWAVE SPECTRA OF FORMALDEHYDE -d_1 -d_2. H.Hirakawa, T.Oka and K.Shimoda.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1207 (Nov., 1956).

535.343

5203. l-TYPE DOUBLING SPECTRA OF HCN AND DCN. H.Hirakawa, T.Oka and K.Shimoda.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1208 (Nov., 1956).

The frequencies between l-type doubling levels are reported for HCN with J = 7 at 12562.46 and for DCN with J = 7 at 10419.88, J = 8 at 13394.50 and J = 9 at 16739.42 ± 0.03 Mc/s. D.H.Whiffen

535.343.07

5204. INFRARED ABSORPTION CELLS FOR MEASUREMENTS AT DIFFERENT TEMPERATURES. E.Funck.
Optik, Vol. 13, No. 11, 524-8 (Nov., 1956). In German.

Describes the construction of cells (a) heated by circulating fluid (b) electrically heated up to 250° C (c) cooled, with the windows warmed by wire grids. G.F.Lothian

535.345

5205. ABSORPTION COEFFICIENTS FOR FREE-FREE TRANSITIONS IN A HYDROGEN PLASMA. J.M.Berger.
Astrophys. J., Vol. 124, No. 3, 550-4 (Nov., 1956).

Absorption coefficients for free-free transitions in a dilute hydrogen plasma have been calculated numerically, making use of results obtained for bremsstrahlung from Sommerfeld's exact treatment and from the Born approximation as modified by Elwert. Results were obtained for a range of temperatures from 0.5 to 100.0 eV and a range of wavelengths from 500 to 10 000 A. These results, including Gaunt factors, are tabulated. A.

535.345

5206. ABSORPTION OF DYES IN THE METASTABLE STATE. E.Laffitte.
Cahier de Phys., No. 71-72, 53-5 (July-Aug., 1956). In French.

A solid solution of fluorescein in Plexiglass is cooled to 180°C and irradiated to excite the fluorescein molecules to a metastable state. The change in intensity of the absorption band at 4500 A, indicates that about 50% of the molecules are in the metastable state and do not return immediately to the ground state. G.Allen

535.345 : 535.37

5207. TRANSMISSION OF RADIATION IN A HETEROGENEOUS MEDIUM. V.V.Sobolev.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 1000-3 (1956). In Russian.

Mathematical discussion of a special case, i.e. the determination of the luminescence in a semi-infinite space consisting of plane-parallel layers with a spherical polar surface of dispersion, assuming that the ratio of the coefficient of dispersion to the sum of this coefficient and that of true absorption is a function of the optical depth. F.Lachman

535.345

5208. ABSORPTION COEFFICIENTS FOR EXCITON ABSORPTION LINES. G.Dresselhaus.
Phys. Rev., Vol. 106, No. 1, 76-8 (April 1, 1957).

The absorption coefficient for excitons is calculated in the effective-mass approximation. The coefficient is shown to be decreased over what one would expect for a collection of free atoms by the factor $\epsilon^{-1}(a_0/a_B)^3$, where ϵ is the dielectric constant and a_0/a_B is the ratio of the lattice constant to the exciton radius. This result seems not inconsistent with the identification of the observed absorption lines in Cu_2O, CdS, HgI_2, PbI_2, and CdI_2 as exciton lines. A.

535.361.2

5209. GLOSS OF MACHINE GLAZED PAPERS. J.Nishiwaki.
J. Phys. Soc. Japan, Vol. 12, No. 1, 53-7 (Jan., 1957).

The flux I_0 reflected at specular angles 45°-45° from the surface of glossy paper and the assumed value of its diffuse component I_2 defined experimentally are measured with a goniophotometer. The ratio of I_0 to I_2 is taken as a measure of gloss, and denoted by G_{NF}. For a series of machine-glazed papers differing considerably in colour, the values of G_{NF} are compared with the visual gradings of 36 Japanese observers, and a linear correlation of the logarithm of G_{NF} with the visual gloss is found with a correlation coefficient +0.986 except for two papers. The method of determining the value of I_2 is described and the voting distributions of the observers for the gloss of the papers are discussed. A.

535.37 : 535.377

5210. IMPURITY-ACTIVATED CRYSTALLINE PHOSPHORS. THEIR PRODUCTION AND THERMOLUMINESCENCE CURVES. A.Wrzesińska.
Acta phys. Polon., Vol. 15, No. 3, 151-62 (1956).

Some useful observations made when searching for methods of making strongly glowing phosphors (of not very pure materials) are reported. A simple apparatus has been constructed which traces the glow curve directly on the photographic paper by means of a light spot. A uniform increase of temperature is easy to obtain. Some observations concerning the influence of Mg on the depth of electron traps have been made. Two new methods of finding the depth of electron traps (without approximate calculations) have been applied to the produced phosphors. A.

535.37

5211. A NOTE ON THE DIFFUSION CONTROLLED PROCESSES IN LUMINESCENT SOLUTIONS. A.Jabłoński.
Acta phys. Polon., Vol. 15, No. 4, 263-6 (1956).

A physical meaning is given to a constant λ_{ij} introduced by the writer in his earlier papers. A.

535.37 : 537.312.5

5212. THEORY OF DYNAMIC QUENCHING OF PHOTOCONDUCTIVITY AND LUMINESCENCE. F.Matossi.
J. Electrochem. Soc., Vol. 103, No. 12, 662-7 (Dec., 1956).

The influence of infrared radiation or electric fields on photoconductivity and luminescence can be described by the following simplified model. Electrons are excited to empty centres and/or filled traps are emptied. Furthermore, radiationless transitions from conduction band to centres may be induced. The "dynamic quenching" curves (dependence of quenching effects on time) of photoconductors continuously excited to equilibrium conduction or luminescence are obtained from the particle balance between the energy levels of the model. Good qualitative agreement with experimental results of conductivity quenching of CdS is obtained by adjusting the parameters of the theory, viz., transition probabilities, efficiencies of centre-filling and trap-emptying, and equilibrium densities of conduction electrons and empty centres. In some cases, it is necessary to assume the existence of two kinds of centres or traps with different values of the parameters. Simple approximate formulae for computing the numerical values of the parameters from characteristic features of the dynamic quenching curves are derived. A.

535.37 : 548.7

5213. STRESS ACTIVATED LUMINESCENCE IN X-IRRADIATED ALKALI HALIDE CRYSTALS.
F.I.Metz, R.N.Schweiger, H.R.Leider and L.A.Girifalco.
J. phys. Chem., Vol. 61, No. 1, 86-9 (Jan., 1957).

The luminescence caused by stressing crystals of potassium bromide, sodium chloride, and lithium fluoride containing F-centres produced by X-rays has been investigated in the region of plastic flow. Light output was measured under varying conditions of irradiation time and strain rate. Rate of light output shows a linear dependence on strain rate (from 12.1 to 116%/min) for all three materials. It is shown that a process by which F-centre electrons are excited to the conduction band by thermal spikes associated with the movement of dislocations, with subsequent recombination with a vacancy or a halogen atom, can account for the experimental observations. A.

535.37

5214. THERMAL QUENCHING IN ALPHA- AND GAMMA-EXCITED FLUORESCENT SOLUTIONS.
H.H.Seliger and C.A.Ziegler.
J. Res. Nat. Bur. Stand., Vol. 58, No. 3, 125-6 (March, 1957).

The effects of reduction of temperature on the relative light outputs of the gas-free liquid scintillators: 2,5-diphenyloxazole (DPO), 2-(1-naphthyl)-5-phenyloxazole (αNPO), phenylbiphenyloxadiazole-1,3,4 (PBD), anthracene and p-bis(2-(5-phenyloxazolyl))-benzene (POPOP), all dissolved in xylene, have been investigated. From room temperature down to −35°C the relative light outputs increase markedly under both alpha and gamma-excitation. Under the conditions of the present experiments it has been possible to make a gas-free solution of PBD + POPOP in xylene more efficient than crystal anthracene. A.

535.37 : 537.311.33

IMPURITY-CENTRE ELECTRONS IN PHOSPHORS.
See Abstr. 4332

535.371

5215. TRANSFER OF ENERGY IN ORGANIC CRYSTALS.
P.Pesteil and A.Zmerli.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1506-9 (Nov. 12, 1956). In French.

535.371

5216. THEORY OF THE EFFECT OF CONCENTRATION ON THE DECAY OF FLUORESCENCE IN SOLUTIONS.
B.Ya.Sveshnikov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 1, 78-81 (1956). In Russian.

It is known that, in most cases of concentration quenching, the fluorescence yield decreases more rapidly than the duration of luminescence. T.Förster (Z. Naturforsch., Vol. 4a, 321, 1949) explained this fact by the deviation of fluorescence decay in concentrated solutions from exponential law. Both he and Galanin (Abstr. 5007/1956) developed equations according to which the fluorescence decay for a set of excited molecules does not obey an exponential law. The author finds inconsistencies and inaccuracies in both derivations. F.Lachman

535.371

5217. ENERGY STATES AND LUMINESCENT PROCESSES IN THE ZnF_2 : Mn PHOSPHOR. P.D.Johnson and F.L.Hughes.
J. chem. Phys., Vol. 26, No. 3, 612-17 (March, 1957).

Single crystals of ZnF_2 : Mn have a single symmetrical thermoluminescent peak when excited by monochromatic radiation of wavelength 1800 to 2300 A. The electron trap responsible for this peak is a metastable state of the activator. Excitation occurs first to a higher excited state from which both the emitting and trapping states are accessible. With 1850 A excitation, transfer to the emitting state from the initial excited state is approximately 4 times as probable as transfer to the trapping state. Untrapping occurs by a monomolecular process modified by thermally activated retrapping from the state governing the rate of emission. Energy level diagrams are proposed for the states of Mn^{++} responsible for absorption emission and trapping. A.

535.371

5218. ON THE INFRARED FLUORESCENCE OF SIMPLE MOLECULES. S.W.Benson and G.R.Porter.
J. chem. Phys., Vol. 26, No. 3, 714 (March, 1957).

In experiments designed to measure rates of collisional deactivation and of radiative transitions of vibrational levels, gases such as CO, CO_2, HCl and HCN at pressures up to 10 cm Hg were exposed to intense infrared radiation. No infrared fluorescence could be detected. Difficulties inherent in the experiment are to achieve adequate absorption of the radiation at low pressures, and to compensate for the disturbing effects of long wavelength background radiation from the exit slit. S.T.Henderson

535.371

5219. LUMINESCENCE OF THIN LAYERS OF CuI AT VERY LOW TEMPERATURES. S.Nikitine and R.Reiss.
J. Phys. Radium, Vol. 17, No. 12, 1017-18 (Dec., 1956). In French.
See also Abstr. 2054 (1957).

535.372

5220. PHOSPHORESCENCE SPECTRA OF ORGANIC CRYSTALS AT 20°K. A.Zmerli, P.Pesteil and L.Pesteil.
Cahiers de Phys., No. 71-72, 55-7 (July-Aug., 1956). In French.

A short review of the interpretation of the luminescence spectra of benzene and naphthalene. G.Allen

535.372

5221. MOLECULAR PHOSPHORESCENCE AT ORDINARY TEMPERATURES. R.Lochet, B.Rybak, A.Rousset and F.Valentin.
Cahiers de Phys., No. 71-72, 57-60 (July-Aug., 1956). In French.

An apparatus for obtaining phosphorescence spectra is described. 140 samples of aminoacids have been studied and it is claimed that the spectra are specific and useful for chemical analysis. G.Allen

535.372 : 535.343

5222. LOW TEMPERATURE EMISSION AND ABSORPTION SPECTRA OF PbI_2.
S.Nikitine and G.Perny.
J. Phys. Radium, Vol. 17, No. 12, 1017 (Dec., 1956). In French.

The spectra depended slightly on how the PbI_2 samples were prepared. All showed a red luminescence and the intensity of emission spectra was strongly dependent on temperature. Some of the results may be caused by the possible presence of AgI. L.Bovey

535.375.5

5223. ON THE INFLUENCE OF THE TEMPERATURE ON THE WIDTH OF [RAMAN] LINES OF CARBON TETRACHLORIDE. B.Moszyńska.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 11, 769-74 (1956). In French.

The Raman lines of CCl_4 at 459 cm^{-1}, 217 cm^{-1}, and 314 cm^{-1} have been studied at temperatures of 20°C, 55°C and 65°C. Increases of width with temperature are recorded for all three lines. G.I.W.Llewelyn

535.375.5

5224. RAMAN SPECTRA OF ISOMORPHS OF $(NH_4)H_2PO_4$ AND $(NH_4)H_2AsO_4$. J. Chapelle and C.Delain.
Cahiers de Phys., No. 71-2, 68-9 (July-Aug., 1956). In French.

Raman frequencies observed for the isomorphs are in good agreement with those observed for the pure phosphate and arsenate. The correlation between the respective depolarization factors is discussed. G.I.W.Llewelyn

535.375.5

5225. RAMAN EFFECT IN MIXTURES OF SOME ESTERS WITH PHENOL AND ALCOHOLS: HYDROGEN BOND FORMATION. P.G.Puranik.
J. chem. Phys., Vol. 26, No. 3, 601-3 (March, 1957).

The variations in the frequencies of some of the Raman lines of methyl and ethyl benzoates and ethyl cinnamate, in phenol and methyl alcohol, have been recorded for different concentrations. In all the three cases the C=O frequencies at 1724, 1719, and 1711 cm^{-1} are lowered as a result of hydrogen bond formation. This reduction is always accompanied by an increase in the frequencies assigned to the C–O link, which is adjacent to the C=O link. Besides these, variations in other frequencies are reported and explained. A.

535.375.51

5226. DEPOLARIZATIONS AND INTENSITIES IN THE COMBINATION SCATTERING [RAMAN] SPECTRA OF BENZENE AND HEXADEUTEROBENZENE. M.A.Kovner and B.N.Snegirev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 5, 835-8 (1957). In Russian.

Obtains relationships between the bond polarizabilities and their derivatives from the Raman intensities and depolarization factors (see Abstr. 6944/1955) for benzene. The detailed theory is given. D.H.Whiffen

535.376

5227. BUILDUP OF ELECTROLUMINESCENT BRIGHTNESS. C.H.Haake.
J. appl. Phys., Vol. 28, No. 2, 245-50 (Feb., 1957).

The buildup of electroluminescent brightness is compared to the buildup of photoluminescence under various conditions which affect the electron population in traps. A qualitative explanation is proposed as to the mechanism of buildup and conclusions are drawn which confirm the observation that electroluminescence is confined to small regions in the phosphor crystals. A.

535.376

5228. ELECTROLUMINESCENCE DETERIORATION. W.A.Thornton.
J. appl. Phys., Vol. 28, No. 3, 313-16 (March, 1957).

Electroluminescence intensity of phosphor layers decreases with running time; this decay can be described by the empirical expression, proposed by Roberts, $L = L_0/(1 + t/t_{1/2})$, where $t_{1/2}$ is the time to half-intensity. It is also observed that, during electroluminescence decay at room temperature, (1) photoluminescence remains constant, (2) a component of the dark capacitance decreases in proportion to the light output, (3) photoconductivity and dark conductivity show a similar decrease, and (4) the light output waveform shows marked progressive changes. Also, (5) decay at 80°K proceeds at a much slower rate. An approximate derivation of an expression describing trap or donor depletion by electrolysis serves to correlate the data and the empirical expression in the foregoing. A.

535.376

5229. EFFECT OF CRYSTAL DISORDER ON THE ELECTROLUMINESCENCE OF ZINC SULFIDE PHOSPHORS. A.H.McKeag and E.G.Steward.
J. Electrochem. Soc., Vol. 104, No. 1, 41-5 (Jan., 1957).

A blue electroluminescent ZnS phosphor was prepared by prefiring precipitated ZnS at a high temperature, activating with Cu, and refiring at about 700°C. The material was characterized by strong pale blue electroluminescence throughout the body of the crystal. The Cu entered most effectively at that temperature of refiring where the transformation from hexagonal to cubic structure occurred most readily. This transformation was associated with a process of one-dimensional disorder in the crystals, and it is suggested that for maximum electroluminescence brightness, fullest use must be made of the disorder process simultaneously with the entry of the activator. A.

535.376

5230. CONTACT ELECTROLUMINESCENCE. W.Lehmann.
J. Electrochem. Soc., Vol. 104, No. 1, 45-50 (Jan., 1957).

Many powdered crystal phosphors which are normally nonelectroluminescent become electroluminescent if they are simply mechanically mixed with suitable powdered metals, or with some nonmetals of good electrical conductivity. The conclusion is drawn, and supported by many facts, that ordinary electroluminescence in powdered phosphors excited by an alternating electric field (Destriau effect) is also due to substances of relatively high conductivity incorporated as small segregations within the essentially insulating phosphor particles. The electric field near sharp edges of these "contact substance" particles is considerably higher than the average electric

field across the phosphor crystals. Preconditions for the electroluminescent excitation process are fulfilled in these localized regions of high field strength. A.

535.376

5231. LIGHT OUTPUT OF POTASSIUM IODIDE CRYSTALS UNDER BOMBARDMENT BY CARBON IONS. W.E.Burcham.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 309-13 (April, 1957).

The response of a KI-Tl scintillator to carbon ions with energies up to 113 MeV is investigated. Response is linear to about 5% in the range 70-113 MeV but the light output per unit energy absorbed is only 0.55 that for equivalent velocity α-particles. G.F.J.Garlick

535.376

5232. THE INFLUENCE OF CHARGE CARRIER INJECTION ON ALTERNATING FIELD ELECTROLUMINESCENCE. D.Hahn and F.W.Seemann.
Z. Phys., Vol. 146, No. 5, 644-54 (1956). In German.

Experiments were made on electroluminescent cells with the electrodes either in contact with the phosphor, or with one or both of them insulated from the phosphor. The light output was measured from either side, and from the edge of the cell. It is shown that electrode effects are largely responsible for lack of symmetry in waveforms of light output. To the nearly symmetrical "volume" luminescence waveforms may be added light from the phosphor due to electron movement into the exhaustion region in contact with the anode, or due to electron injection into the phosphor at the cathode. S.T.Henderson

535.377

5233. ON THE SECOND-ORDER DECAY OF THE THERMO-LUMINESCENCE OF POLYCRYSTALLINE MATERIALS. P.K.Weyl.
J. chem. Phys., Vol. 26, No. 3, 547-51 (March, 1957).

The results of an isothermal decay and glow-curve experiment for a thermoluminescent material having second-order kinetics have been investigated. In contrast to the first-order case, the location of the peak of the glow curve depends on the initial trap density. The effect of a distribution of trap densities for a polycrystalline material is investigated. It is found that for a narrow distribution function, a plot of the reciprocal of the square root of the light intensity v. the time in the isothermal decay experiment will give a straight line whose slope and intercept will depend on the distribution function. The location of the peak of the glow curve is not materially affected by the distribution function, and from its location and the energy of the trap depth, a parameter proportional to the initial trap density and independent of the optical efficiency can be determined. Plots of first- and second-order generalized glow curves are presented from which the parameters of an experimental curve can be determined. A.

535.39

5234. REFLECTIVITY OF VACUUM-EVAPORATED SELENIUM FILMS AT WAVELENGTHS FROM THE VISIBLE TO THE FAR ULTRAVIOLET. S.Kandare.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 571-4 (Jan. 28, 1957). In French.

Both amorphous and crystallized films about 0.5μ thick were prepared, and their reflectivity measured at an angle of incidence of 18°. The amorphous films have an almost constant reflectivity of 25% from 1180-6300 A, though there are minor maxima and minima between 2800 and 5500 A. The crystalline films have a reflectivity of 6% in the far u.v. and this rises rapidly with wavelength from 2500 A, reaching over 40% in the visible; the same maxima and minima are observed as for amorphous films, but here they are more intense. The results are interpreted in terms of electronic transitions. C.Hilsum

535.39 : 539.23

5235. A THEORY OF MULTILAYER DIELECTRIC COATINGS. V.V.Sukhanovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 2, 245-8 (1954). In Russian.

A general matrix equation for such coatings, and a formula for the intensity of light transmitted through them are given and discussed. It is claimed that the theory enables one to analyse, with any desired accuracy, an arbitrary two-component coating of 2n+1 layers, or any system of such coatings. This analysis includes the determination of the number of layers, their order, and the optical thickness of each of them. An experiment is quoted in which the coefficient of reflection R_{max} was measured for 3-, 5- and 7-layer coatings. The values of R_{max} and their dependence on wavelength were found to be in agreement with the theory. S.Chomet

535.39 : 541.182.022

5236. OPTICAL STUDY OF STRATIFIED LAYERS OF HAEMIN DEPOSITED ON A SOLID SUPPORT. R.Rinaldi and S.Rosi.
J. Phys. Radium, Vol. 17, No. 12, 997-1000 (Dec., 1956). In French.

Continues earlier measurements (see Abstr. 8663/1955). The transmissions, T, and reflections, R, are measured around the absorption band near 4000 A for layers of up to 60 monomolecular films. When the separate films are formed under compression by adjacent areas of surface the curves of T and R against wavelength have the appearance given by homogeneous, strongly absorbing (metallic), layers. G.F.Lothian

535.391

5237. CONTRIBUTION TO THE THEORY OF REDUCTION OF REFLECTION WITH MULTILAYERS. A.Thelen.
Optik, Vol. 13, No. 12, 537-42 (Dec., 1956). In German.

Formulae in the literature for computing the reflective coefficients of multilayer anti-reflectors are cumbersome to use. Simplified forms are derived here which are close approximations both for low and high reflecting multilayer systems. The formulae are used for deriving the condition giving both null reflection from a double layer for a single wavelength, whilst at the same time an appreciable reduction is required over as wide a wavelength range as is possible. S.Tolansky

535.393

5238. REFLECTION FACTORS OF THIN FILMS OF GALLIUM. J.Tortosa.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2031-4 (Dec. 17, 1956). In French.

Very pure Ga was evaporated on to glass slides, and measurements are reported of the reflection at the glass-film interface, as a function of the film thickness up to 500 A, for three wavelengths in the visible spectrum. The measurements were made without removing the films from the vacuum, thickness measurements being made by weighing. The effects of varying the rate of deposition of the film were found to be small. It was found that the reflection coefficient decreased by as much as 20% on exposing the film to the atmosphere. D.G.Avery

535.412

5239. ON A THEORY OF LOCALIZATION OF MACH–ZEHNDER INTERFEROMETER. H.Hannes.
Optik, Vol. 14, No. 4, 165-77 (April, 1957). In German.

With the aid of a localization theorem due to Th.Fromme a formal relation between mirror orientation and fringe position in the Mach–Zehnder interferometer may be derived. With the aid of this result an interferometer with a novel adjustment is described. In addition, the displacement of the plane of localization of the fringes with change in path-difference due to displacement of one of the mirrors is discussed. A

535.41

5240. THE FORMATION OF WHITE LIGHT FRINGES OF EQUAL CHROMATIC ORDER. N.Barakat.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 256-7 (Feb., 1957).

The focal properties of the surfaces are discussed for fringes of equal chromatic order appearing at other than the zero-order Feussner surface. It is shown that for orders higher than zero the focus is sharp over a limited wavelength range only. S.Tolansky

535.417 : 535.322

5241. MEASUREMENT OF THE DISPERSION OF LIQUIDS IN THE INFRARED BY AN INTERFEROMETRIC METHOD. J.Vincent-Geisse and J.Lecomte.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 577-80 (Jan. 28, 1957). In French.

An interferometer is described using a cell of variable thickness for use with liquids having numerous absorption bands. Results for carbon tetrachloride, chloroform and benzene in the region 6-16μ are given. R.W.Fis

535.41

5242. A FABRY–PEROT ETALON WITH DIELECTRIC MIRRORS. F.A.Korolev and V.V.Sukhanovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 1, 53-5 (1954). In Russian.

These mirrors consist of multilayer coatings of ZnS and Na_3AlF_6, and are produced by evaporation in a high vacuum. It is possible to produce them with a reflection coefficient $R \sim 95\%$ and an absorption coefficient $A \to 0$ in the visible and infrared parts of the spectrum. The quarter-wave multilayer coating appears to be the most suitable for the Fabry–Perot etalon. Because of the somewhat higher values of R, higher resolution is obtained. A microphotograph is shown of the green line of Hg (λ = 5461 A) as

resolved by such an etalon. For this a seven-layer coating was used (R = 94%; A = 0 as compared with R = 92%; A = 4% for metallic mirrors under similar conditions). The improvement in resolution can be clearly seen in the photograph. S.Chomet

535.417

5243. A THREE-BEAM INTERFEROMETER FOR THE INVESTIGATION OF ANOMALOUS DISPERSION. G.P.Startsev.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 6, 1181-4 (1954). In Russian.

The Fraunhofer diffraction pattern from three equal and equidistant slits is studied. When a vapour is introduced into the path of the light from the middle slit, the relative intensities of the subsidiary and principal maxima are visibly affected. Since this change is a function of wavelength it can be used to study the anomalous dispersion of the vapour. This is done by crossing the fringe system with a glass spectrograph. In the region of anomalous dispersion a "break-up" of the fringe system occurs. S.Chomet

535.417

5244. CONSTRUCTION OF A KÖSTERS DOUBLE-IMAGE PRISM. J.B.Saunders.
J. Res. Nat. Bur. Stand., Vol. 58, No. 1, 21-6 (Jan., 1957).

An interferometric method is described for use in constructing and adjusting double-image prisms of the Kösters type. The faces of the prisms form the elements of several interferometers that are used for testing and for making adjustments during construction. The prisms are cemented together and are quite stable. The precision attainable in the adjustments approaches interferometric perfection. A.

535.417 : 535.8

5245. THE KÖSTERS INTERFEROMETER. J.B.Saunders.
J. Res. Nat. Bur. Stand., Vol. 58, No. 1, 27-31 (Jan., 1957).

Results are given on an investigation of the Kösters double-image prism. Some of these results are not in harmony with those given by other investigators. A modification of the Kösters prism is described that forms a simple interferometer that is easy to apply to the testing of lenses, mirrors, and combinations of these elements. A practical test is given for determining the maximum size of the source that is usable in any interferometer. A.

535.417

5246. REMARKS ON THE APPLICATION OF LYOT FILTERS TO THE OPTICAL REPRESENTATION [OF SPECTRAL LINES]. K.Mie.
Optik, Vol. 14, No. 1, 1-23 (Jan., 1957). In German.

The theoretical basis of the Lyot interference filter is outlined. Among several aspects discussed are the choice of filter bandwidth in relation to spectral line-width to be recorded; and the effect of the spectral background on image contrast, as influenced by the optimal bandpass of the filter. D.R.Barber

535.417 : 531.715

5247. THICKNESS MEASUREMENT OF MICROSCOPIC OBJECTS BY THREE-SLIT AND TWO-SLIT INTERFERENCE (PROBE METHOD). E.Menzel.
Optik, Vol. 14, No. 4, 151-64 (April, 1957). In German.

A commercial microscope for direct and reflected illumination is adapted for the measurement of thickness by triple-slit interference. The object plane together with the reduced image of the triple slit is projected to infinity and observed by means of a telescope. The characteristic planes of interference are now equidistant and will appear in the telescope after insertion of a cylindrical lens the axial displacement of which may be read off. Phase contrast facilitates the required covering of the two slits. A filament lamp together with filters provide the light source. The arrangement may also serve to measure longer path-differences using then the double-slit interference. The two methods are particularly suitable for the measurement of the thickness of microtome sections and thin films. A.

535.42 : 538.3

5248. ON BABINET'S THEOREM, IN TERMS OF ELECTROMAGNETIC THEORY. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1743-5 (Nov. 26, 1956). In French.

535.42 : 534.39

5249. THE DIFFRACTION OF LIGHT BY A PROGRESSIVE PLANE ULTRASONIC WAVE. CALCULATION OF RAY INTENSITIES. N.Segard and J.Pouliquen.
C.R. Acad. Sci. (Paris), Vol. 244, No. 3, 327-9 (Jan. 14, 1957). In French.

The differential equation governing the diffraction has been integrated to obtain the path differences. It is shown that the diffraction field is similar to that formed by two separated glass diffraction gratings and thus the intensity can be calculated for each order of diffraction. R.W.Fish

535.42 : 534.321.9

5250. EXPERIMENTAL DECAY LAW OF THE DIFFRACTED LIGHT REMAINING IN THE LIQUIDS AT THE STOPPING OF THE ULTRASONIC WAVES. F.Porreca.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 679-87 (Oct., 1956).

A careful attempt has been made to demonstrate the permanence of the ultrasonic grating in liquid suspensions. The decay time of the diffracted lines after cessation of the ultrasonic wave as well as their intensity have been measured using photomultipliers in conjunction with a rapid response cathode-ray tube. It is thought that a knowledge of intensity is important to an understanding of the electrical conditions surrounding suspended particles. The experimental work is fully described and great care has obviously been taken, for example the zero order light is shielded to ensure the highest possible sensitivity. It is found that the refractive index decays exponentially with time and it is thought that a measure has been obtained of the electrical interaction between colloidal particles and the dipoles of the dispersing liquid. T.C.Toye

535.43

5251. STUDY OF THE SCATTERING OF LIGHT BY AMMONIUM PHOSPHATE AND SODIUM CHLORIDE SINGLE CRYSTALS. L.Taurel.
Cahiers de Phys., No. 73, 22-4 (Sept., 1956). In French.

The variations in the scattered luminous flux with temperature are discussed and compared with theory. Good agreement has been obtained. G.I.W.Llewelyn

535.43 : 535.51

5252. TRIGONOMETRICAL SERIES METHOD IN SOLVING THE PROBLEM OF SOFTENING AND DEGREE OF POLARIZATION OF RADIATION IN AN ELECTRON ATMOSPHERE, SCATTERING ACCORDING TO RAYLEIGH'S LAW AND INVOLVING COMPTON CHANGE IN WAVELENGTH. K.K.Sen.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 6, 337-62 (1956).

The problem of the softening of radiation due to multiple Compton scattering in an axially symmetric, plane parallel electron atmosphere, scattering according to Rayleigh's law and taking into account the polarization of the radiation field has been solved in the first approximation by the method of trigonometrical series. The intensity distribution and the distribution of the degree of polarization of the outcoming radiation for a monochromatic and a Gaussian distribution of the base have been calculated and the intensity distribution has been compared with the corresponding distribution when polarization is not taken account of. A.

535.43 : 537.311.33

ELECTRICAL AND OPTICAL PROPERTIES OF HEAT-TREATED SILICON. See Abstr. 4351

535.434

5253. THEORETICAL INVESTIGATIONS ON THE LIGHT SCATTERING OF COLLOIDAL SPHERES. I. THE SPECIFIC TURBIDITY. W.Heller and W.J.Pangonis.
J. chem. Phys., Vol. 26, No. 3, 498-506 (March, 1957).

Scattering cross-sections, scattering coefficients and specific turbidities are calculated from the Mie equations for α = 0.2 (0.2) 7.0 (1) 15 and m = 1.05 (0.05) 1.30; and, in addition, for α = 22 (2) 32; 39 (1) 41 and m = 1.05, for α = 16 (1) 21 and m = 1.10, for α 7.2 (0.2) 15.2 and m = 1.20. Thus, the calculations cover virtually all dispersed systems of ultramicroscopic or small microscopic nonabsorbing spherical particles dispersed in a liquid. The effect of α and m upon these functions is discussed and a few approximating equations are given and tested for the limit of $\alpha \to \infty$. The most important features of the Mie theory are briefly discussed and compared with those of alternate approximating theories. A.

535.434

5254. THEORETICAL INVESTIGATIONS ON THE LIGHT SCATTERING OF COLLOIDAL SPHERES. II. ACCURATE INTERPOLATIONS OF THEORETICAL TURBIDITY-DATA. W.Heller.
J. chem. Phys., Vol. 26, No. 4, 920-2 (April, 1957).

For Pt I, see preceding abstract. The quantity $\log[(\tau/c)_0\lambda]$ is found to vary linearily with $\log(m-1)$ if α is kept constant. The relationship is valid as long as α does not exceed about 2/3 of that value at which the first turbidity maximum is attained. This relationship can be used for precise and accurate interpolations of theoretical $(\tau/c)_0$ data, derived from the Mie theory, for any intermediate m

values. To a limited extent, extrapolations to m values pertinent to aerosols are also possible. The α and m range of practical usefulness of the graphical or numerical method of interpolation or extrapolation is quantitatively defined. A.

535.435/.436

5255. A STUDY OF THE EFFECT OF CORRELATIONS ON THE DEPOLARIZATION OF SCATTERED LIGHT. APPLICATION TO A GAS, TO DILUTE SOLUTIONS AND TO MACROMOLECULAR CHAINS. H.Benoit and G.Weill.
Cahiers de Phys., No. 71-72, 60-3 (July-Aug., 1956). In French.

The influence of correlations between the orientations of the molecules of a fluid on the depolarization is considered. The treatment neglects the anisotropic fluctuations of the internal field. G.Allen

535.435/.436

5256. MEASUREMENT OF THE MOLECULAR OPTICAL ANISOTROPY FROM RAYLEIGH SCATTERING. R.Lochet, A.Massoulier and A.Rousset.
Cahiers de Phys., No. 71-2. 63-6 (July-Aug., 1956). In French.

The correlation between the molecular anisotropies of the gaseous and liquid states is discussed. The variation of anisotropy with concentration for (a) solutions of nitrobenzene, benzene and acetic acid in CCl_4, and (b) aqueous solutions of electrolytes which form isotropic ions, is graphically represented. G.I.W.Llewelyn

535.515

5257. THE MEASUREMENT OF EXPERIMENTALLY PRODUCED OPTICAL PHASE DIFFERENCES IN NATURAL CRYSTALS. W.Voigt.
Optik, Vol. 14, No. 1, 28-33 (Jan., 1957). In German.

A method of measuring small amounts of double refraction is described. This has a small field as well as high sensitivity so that local strains in natural crystals can be detected. The results of some measurements on mica are given. R.W.Fish

535.56.08

5258. PHOTOELECTRIC MEASUREMENTS OF WEAK BIREFRINGENCES AND VERY SMALL ROTATORY POWERS. J. Badoz.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 143A-149A (Nov., 1956). In French.

The experimental factors which are necessary to get high sensitivity are given and discussed for various applications such as the measurements of the Kerr effect, Cotton–Mouton effect, Maxwell effect, Lucas effect and photoelasticity. Two methods of detection may be used, one in which the photoelectric current is proportional to the square of the incident light intensity (quadratic detection), and the other in which the current is directly proportional to the intensity (linear detection). It is stated that with quadratic detection a path difference of $2.5 \times 10^{-6}\lambda$ and a rotation of 1.55'' can be measured. With linear detection the corresponding limits are $1.3 \times 10^{-8}\lambda$ and 0.0087''. H.G.Jerrard

535.65

5259. WHITENESS AND METHODS OF ITS MEASUREMENT. E.N.Yustova.
Svetotekhnika, 1957, No. 2, 16-19. In Russian.

Discusses three methods of estimating the whiteness of opaque bodies, based respectively on spectrophotometry, photometry and colorimetry. Measurements by the first and second of these methods either do not take into account or do not correspond with the characteristics of human vision, whereas a direct relationship was established between the results of colorimetric measurements and visual sensations (MacAdam, J. Opt. Soc. Amer., Vol. 24, 1934). The diagrams present the results of measurements conducted on paper and other white materials by means of V.N.I.I.M. visual trichromatic colorimeter. The sensitivity thresholds in the region of white colours are discussed. F.Lachman

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.81

5260. DETERMINATION OF THE REFLECTION COEFFICIENT OF AN ARSENIC PENTASELENIDE GLASS. G.Dewulf and F.Gans.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1857-9 (Dec. 5, 1956). In French.

The reflection coefficient has been measured over the wavelength range 2-15 μ. The valves obtained indicate a refractive index of 2.57, a reflection coefficient of 0.32 and a transmission of 0.65-0.70. There is very little absorption. R.W.Fish

535.88 : 518.5

5261. A SLIDE RULE FOR FILM PROJECTION. H.Jensen.
Optik, Vol. 13, No. 12, 543 (Dec., 1956). In German.

A slide rule is described intended for use by cinema projectionists. It solves the equations governing screen height and breadth, lens focal length, film format, etc. R.W.Fish

HEAT 536

536.2.02 : 551.524.3

5262. ON THE INTEGRATION OF THE HEAT-CONDUCTION EQUATION WITH PERIODIC VARIATION OF TEMPERATURE. D.A.de Vries.
J. Meteorol., Vol. 14, No. 1, 71-6 (Feb., 1957).

An integration of the Fourier equation of heat conduction in a semi-infinite medium (air) is presented for the case where the thermal (or eddy) diffusivity varies with height, assuming a harmonic variation of temperature with time. Special attention is paid to the case where the medium consists of an arbitrary number of layers in each of which the diffusivity is represented by a different function of height. Application of these methods resolves some of the difficulties encountered in explaining the observed variation of amplitude and phase of the temperature wave with height. It is concluded that — although theoretically possible — it is not feasible in practice to evaluate the diffusivity from an analysis of observations of this type, and that some results of previous attempts to do so are largely in error. Relations between the waves of temperature and heat flux near the surface are briefly discussed. It is shown that for the diurnal waves these depend, inter alia, on the diffusivity values up to a height of the order of 1000 m. A.

536.2.02 : 536.48

5263. THE THERMAL CONDUCTIVITY OF METALS AT LOW TEMPERATURES. DEVIATIONS FROM IDEAL BEHAVIOUR. H.M.Rosenberg.
Phil. Mag. (Eighth Ser.), Vol. 2, 541-7 (April, 1957).

Measurements of the thermal conductivity of single crystals of zinc and cadmium have been taken between 2 and 20°K. The results show that a plot of WT against T^3 (where W is the thermal resistance) instead of being a straight line, has linear sections at high and at low temperatures, the slope at high temperatures being about three times that at low temperatures. This behaviour is shown to be connected with the very marked changes which occur in the values of the Debye θ. A.

536.21 : 548.7

5264. THE THERMAL CONDUCTIVITY OF GERMANIUM AND SILICON BETWEEN 2 AND 300°K. J.A.Carruthers, T.H.Geballe, H.M.Rosenberg and J.M.Ziman.
Proc. Roy. Soc. A, Vol. 239, 502-14 (Jan. 29, 1957).

The thermal conductivity of single crystals of pure n-type germanium and of p-type germanium containing from 10^{14} to 10^{19} group III impurity atoms per cm^3 has been measured from 2 to 90°K. In some cases the readings have been extended up to room temperature. Whereas the low-temperature conductivity of the pure specimens is that which one would expect from a dielectric crystal, the addition of even very small amounts of group III impurity decreases the conductivity very considerably and alters its temperature dependence. It is suggested that the extra thermal resistance introduced is due to the scattering of the lattice vibrations by the electrons or holes in the impurity energy levels. The theory of such scattering has been worked out by Ziman, and the experimental results are shown to be in fair agreement with this theory. A pure n-type silicon single crystal and a gold-doped p-type silicon crystal show a behaviour similar to the germanium. The room-temperature conductivity of germanium and silicon is 0.64 and 1.45 watt units respectively. A.

536.212.2 : 536.421.4

5265. GALLIUM: THERMAL CONDUCTIVITY; SUPERCOOLING; NEGATIVE PRESSURE. L.J.Briggs.
J. chem. Phys., Vol. 26, No. 4, 784-6 (April, 1957).

The thermal conductivity of liquid gallium does not appear to have heretofore been measured. The method employed involved a comparison with the known thermal conductivity of mercury. The two liquids were sealed in two thin-walled glass tubes (30 cm long, 10 mm bore), the upper ends being inserted vertically through the bottom of a boiler containing boiling water. The tubes were coated to secure the same thermal emissivity. Two thermocouple loops

which could be moved along the tubes served to establish points having the same temperature on the two tubes. The ratio of the squares of the lengths from the thermocouple junctions to the bottom of the boiler gave 3.51 ± 0.03 as the relative thermal conductivity of gallium to that of mercury, or 0.336 ± 0.005 watt/cm (deg C) as the thermal conductivity of gallium between 30° and 100° C, based upon 0.0958 for mercury. It was found possible to supercool liquid gallium to −28° C, or 58° C below its melting point, by exposing small drops on paper to a slowly decreasing temperature in a deep-freeze chamber with a circulating atmosphere. An attempt to measure the negative pressure of gallium proved disappointing, for it was found that gallium does not "wet" the wall of an evacuated tube. With a partial evacuation, low negative pressures were measured which decreased (like water) as the melting point was approached. A.

536.212.2 : 537.311.31

THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF METALS AT HIGH TEMPERATURES. See Abstr. 4321

536.24 : 536.423.1

5266. STUDY OF BOILING IN SHORT NARROW CHANNELS AND ITS APPLICATION TO DESIGN OF MAGNETS COOLED BY LIQUID H_2 AND N_2. S.G.Sydoriak and T.R.Roberts.
J. appl. Phys., Vol. 28, No. 2, 143-8 (Feb., 1957).

A study has been made of the critical heat input, $\dot{Q}_C$, to liquid H_2 and N_2 boiling in an annular gap, of cross-section area, A, between a vertical cylindrical heater of height, Z, and various concentric plugs. The data are in approximate agreement with calculations based on an assumption of homogeneous and frictionless two phase flow. The pressure drop across the channel is spent primarily to accelerate the vapour being formed and the liquid carried with it. The derived relation does not contain any empirical coefficients or exponents. For $\rho_{V,2} \ll \rho_L$ the general equation reduces to

$$\dot{Q} = A\,L(\rho_{V,2}\rho_L Z_e g f_2)^{1/2},$$

where L is the latent heat of vaporization, $\rho_{V,2}$ the exit vapour density, ρ_L the liquid density, g the gravitational acceleration, Z_e the hydrostatic head equivalent to the pressure drop across the heater and f_2 the mass fraction of vapour in the fluid leaving the heater. Forced flow experiments give f_2. At $\dot{Q}_C$ equal to that found in natural convection boiling, $f_2 \doteq 0.5$ for both liquids. For Z = 3 or in. and a channel thickness of 0.022 in. the ratio of observed to calculated $\dot{Q}$ is 0.95 for N_2 and 0.70 for H_2. The calculation is equally good for critical natural convection experiments, $Z_e = Z$, and for subcritical as well as critical forced flow measurements, which extend up to $Z_e = 70$ Z. The optimum operating vapour pressure is discussed for magnets cooled by ideal natural convection boiling. A simple roll-type of coil is discussed and is shown to be superior in some respects to more conventional windings. A.

536.3 : 551.521.1 : 535.313.2

5267. ANALYSIS OF LARGE APERTURE PARABOLIC MIRRORS FOR SOLAR FURNACES. J.Farber and B.I.Davis.
J. Opt. Soc. Amer., Vol. 47, No. 3, 216-20 (March, 1957).

An analysis is made to determine the most effective areas and estimate maximum attainable temperature for two types of radiation targets. The maximum attainable temperature calculated is 5200° K. A.

536.412

5268. DISCONTINUITIES IN SLOPE OF THE TEMPERATURE DEPENDENCE OF THE THERMAL EXPANSION OF WATER. M.Lavergne and W.Drost-Hansen.
Naturwissenschaften, Vol. 43, No. 22, 511-12 (1956).

An analysis of the data of Chappuis (1907) has shown that a statistically significant better fit is obtained for his data if three distinct curves are used for different temperature regions. This provides additional data for the existance of discontinuities of slope near 15° C and 30° C. J.M.Hough

536.413.3 : 539.11

5269. THE THERMAL EXPANSION OF PURE METALS AND THE POSSIBILITY OF NEGATIVE COEFFICIENTS OF VOLUME EXPANSION. J.H.O.Varley.
Proc. Roy. Soc. A, Vol. 237, 413-21 (Nov. 6, 1956).

The dominant factors controlling the volume thermal expansion of solids are discussed. It is shown that if the Fermi energy of the electron gas has a value for which the density of states of the electrons changes sufficiently rapidly with energy, a negative coefficient of volume expansion may reasonably be expected, particularly if this is associated with a high electronic specific heat from a large number of overlapping bands. It is suggested that this is the reason underlying the observed negative coefficient of volume expansion of the cubic phase in plutonium. A.

536.421.4 : 548.5

5270. ORIENTED SOLIDIFICATION OF SUPERCOOLED WATER ON A CRYSTALLINE SURFACE. SILVER AND SILVER IODIDE. S.Jaffray and R.Montmory.
C.R. Acad. Sci. (Paris), Vol. 244, No. 7, 859-61 (Feb. 11, 1957). In French.

The measuring method used is described in Abstr. 8150 (1956). A silver layer is formed on mica, oriented along (111). At −15° C ice crystals appear on this, with [0001] of ice superimposed on [111] of silver. To form a layer of silver iodide, a silver layer on muscovite mica is attacked by iodine vapour, which results in a mixture of AgI β (cubic) and AgI γ (hexagonal). At −10° C ice crystals are formed on this layer, with (0001) of ice in contact with (0001) or (111) of AgI β or AgI γ. C.Turner

536.422.1

5271. POLYMERIC GASEOUS SPECIES IN THE SUBLIMATION OF MOLYBDENUM TRIOXIDE. J.Berkowitz, M.G.Inghram and W.A.Chupka.
J. chem. Phys., Vol. 26, No. 4, 842-6 (April, 1957).

Mass spectrometric analysis of the vapour in thermodynamic equilibrium with powdered molybdenum trioxide, as sampled from a Knudsen effusion cell, has shown that the vapour phase consists predominantly of Mo_3O_9, Mo_4O_{12} and Mo_5O_{15} molecules. Utilizing the Clausius–Clapeyron equation, individual heats of sublimation have been determined to be 80.5 ± 1.5, 93.6 ± 1.6 and 105.6 ± 3.5 kcal/mole respectively at 850° K. The heats of formation and third law entropies have been evaluated for each of these molecules. A.

536.423 : 530.162

5272. STATISTICAL MECHANICS OF LIQUID-VAPOR EQUILIBRIUM. B.Widom.
J. chem. Phys., Vol. 26, No. 4, 887-93 (April, 1957).

The configuration integral of a pure fluid is approximated by considering configurations in which the N particles are distributed in two sub-volumes of the volume V, the potential energy per particle in each sub-volume being taken to be a function, $u(v_i)$, of the volume per particle in that region, and interaction between sub-volumes being ignored. When all possible distributions of particles between sub-volumes are considered, and when $u(v_i)$ has the form suggested by physical considerations, then the pressure as a function of $v = V/N$ is found to be equal to $\pi(v) = kT/v - u'(v)$ whenever $\pi(v)$ is stable, but to be equal to the constant vapour pressure which satisfies the equal-areas criterion whenever $\pi(v)$ is metastable or unstable. The functions $\pi(v)$ themselves have the form of a set of isotherms of van der Waals type. A.

536.461

5273. FLAME STABILIZATION IN THE BOUNDARY LAYER. S.Wójcicki.
Bull. Acad. Polon. Sci. Cl 4, Vol. 4, No. 4, 293-4 (1956).

The general condition for the stability of a flame in the boundary layer on a flat plate parallel to the stream lines has been shown (the deduction is not given) to be

$$Pe_u = K\,Pe_s^{\alpha}(\lambda d/EAM^2)^{\beta},$$

where $Pe_{u,s}$ are Peclet numbers referred to the flow and the laminar burning velocities, respectively; λ = the thermal conductivity of the plate; d = the plate thickness; M = the Mach number in the flow of mixture; A = the distance of the flame-front from the leading edge; $E = g\kappa R\mu$ where g = acceleration due to gravity, κ = the exponent of isentropic curve (C_p/C_v), R = gas constant, μ = mixture viscosity; K, α, β are dimensionless constants. Experiments indicated $K = 1.05 \times 10^{-48}$, α = 8.1 and β = 3.9. R.C.Murray

536.461 : 534.222.2

5274. COMBUSTION AND DETONATION IN GASES. B.Greifer, J.C.Cooper, F.C.Gibson and C.M.Mason.
J. appl. Phys., Vol. 28, No. 3, 289-94 (March, 1957).

A photographic investigation of combustion in gases was undertaken to observe experimentally the mechanism of initiation and structure of detonation waves. Streak schlieren photographs of hydrogen–oxygen and carbon monoxide–oxygen explosions were made in a rectangular shock tube using precision optics and a rotating mirror camera. The photographs show that compression waves generated during the early stages of propagation of the explosion soon steepen into a shock wave which travels ahead of the combustion wave (zone of chemical reaction). This combination of shock and combustion wave is characteristic of a nonsteady detonation state in the moments before stable detonation is initiated. The distance between the two waves narrows as the explosion progresses down the tube due to the continued formation of new combustion centres ahead of the combustion wave by means of auto-ignitions. Eventually the

combustion wave overtakes the shock wave and supplies it directly with energy from the chemical reaction; at this moment stable detonation is initiated. The internal structure of steady state detonations is found to be different from nonsteady state detonations; for example, whereas the distance between the shock and the zone of chemical reaction is of the order of several centimetres in the nonsteady state detonation, this distance in the steady state detonation is too small to be resolved by the optical system (i.e., less than 1 mm). Other structural features such as spinning detonation and a high-frequency oscillation of propagation velocity are also illustrated. A.

536.462 : 535.333

5275. SPECTROSCOPIC SURVEY OF ENERGY DISTRIBUTIONS OF OH, C_2, AND CH RADICALS IN LOW PRESSURE ACETYLENE–OXYGEN FLAMES. H.P.Broida and D.F.Heath.
J. chem. Phys., Vol. 26, No. 2, 223-9 (Feb., 1957).

Rotational and vibrational "temperatures" from electronic transitions of OH, C_2 and CH radicals have been measured in detail as functions of position in low pressure acetylene–oxygen flames. Pressures were varied from 0.8 to 6.0 mm Hg. Trends of "temperature" are presented as functions of mixture, pressure, position, mass flow rate, and burner size. Abnormalities in "temperature" are discussed. Evidence is presented for the existence of a newly discovered region at the base of the flame. This region is about $\frac{1}{10}$ the visible flame thickness and is characterized by strong emission of C_2 and CH relative to OH and by relatively high "temperatures" of C_2 and CH. Just above this region the OH rotational "temperature" is very high, about 9000° K, and is independent of pressure. A.

536.48

5276. THE THERMAL AND MAGNETIC PROPERTIES OF NEODYMIUM ETHYLSULPHATE AT LOW TEMPERATURES. H.Meyer.
Phil. Mag. (Eighth Ser.), Vol. 2, 521-33 (April, 1957).

The entropy, the specific heat and the absolute temperature have been determined as a function of the magnetic temperature for a single crystal of neodymium ethylsulphate in the temperature range between 0.015 and 1° K by adiabatic demagnetization experiments. The specific heat values were confirmed by determination of the magnetic specific heat between 1° K and 2° K by the paramagnetic relaxation method. The results are compared with those expected from paramagnetic resonance data and from Daniels' extension of Van Vleck's theory of dipolar interaction effects. Good agreement is found down to temperatures of about 0.05° K. A.

536.48

5277. MELTING CURVES OF HELIUM AND HYDROGEN ISOTOPES. C.Domb.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 150-2 (Jan., 1957).

The results of recent measurements of the melting curves of He^4 and He^3 (Abstr. 2037/1956) are discussed in relation to an earlier theoretical treatment of solid helium by the author and a further consideration of this by Dugdale and MacDonald. The indications are that both for the helium isotopes and hydrogen isotopes the melting curves approach one another at higher temperatures and pressures. F.E.Hoare

536.48 : 536.632

5278. THEORY OF SPECIFIC HEAT OF LIQUID HYDROGEN. S.C.Misra.
Indian J. Phys., Vol. 30, No. 12, 626-7 (Dec., 1956).

536.48 : 534.213

5279. OSCILLATIONS OF A FERMI LIQUID. L.D.Landau.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 59-66 (1957). In Russian.

Various types of waves which can be propagated in a Fermi liquid at the absolute zero and at non-zero temperatures are investigated. Absorption of the waves is also considered.

536.48 : 536.632

5280. THE HEAT AND SPECIFIC HEAT OF MIXING OF ^{3}He AND ^{4}He SOLUTIONS. B.K.Agarwal.
Curr. Sci., Vol. 25, No. 4, 112-13 (April, 1956).

These have been calculated by Nanda (Abstr. 6566/1954) from the theories of (i) Heer and Daunt (ii) Van Laar and (iii) de Boer and Gorter. In the present note these functions have been computed using the asymptotic theory of Goldstein. It is shown that the variation of the heat of mixing with temperature is markedly different for the different theories, emphasizing the need for experimental determinations. Comparison with a single observation by Sommers, Keller and Dash, for an 8.6% solution at 1.02° K shows that the value predicted by the Goldstein theory lies closest to the observed value. H.C.Cole

536.48 : 532.14

5281. DENSITY OF LIQUID He^4. E.C.Kerr.
J. chem. Phys., Vol. 26, No. 3, 511-14 (March, 1957).

The density of He^4 under its own vapour pressure has been measured between 1.2° K and 4.4° K by a direct method. The results are given in smoothed tabular form and are compared with the results of previous measurements. An attempt has been made to derive a usable value for the critical density from the liquid and vapour densities at lower temperatures. A.

536.48

5282. ROTATION OF LIQUID HELIUM II. S.M.Bhagat and R.K.Pathria.
Phys. Rev., Vol. 106, No. 1, 3-7 (April 1, 1957).

Experiments concerned with the measurement of viscous resistance in rotating liquid helium II have been analysed on the basis of the stratification model for the superfluid motion. The onset of non-linear dissipation is attributed to the setting in of large-scale vorticity in the superfluid and it is proposed that this would happen at a certain "critical" velocity corresponding to which the thickness of the layers becomes of the order of the "correlation length". The magnitude of the characteristic length turns out to be about 8×10^{-5} cm. Further, the concept of stratified motion has also been applied to linear flow through the supersurface film, leading thereby to a satisfactory explanation of the observations of Chandrasekhar and Mendelssohn. A.

536.48

5283. HYDRODYNAMIC RESISTANCE IN LIQUID HELIUM II AND DETERMINATION OF THE NORMAL CONCENTRATION. S.M.Bhagat and R.K.Pathria.
Phys. Rev., Vol. 106, No. 2, 199-202 (April 15, 1957).

The forces of hydrodynamic reaction in liquid helium II have been studied. Since the superfluid component, being inviscid, may not be expected to contribute to such forces, a measurement of these may provide direct information regarding the concentration of the normal component in the liquid. Experiments along these lines are suggested and it is hoped that they may throw light on the phenomena of "critical velocity" and on the irrotational nature of the superfluid motion. A.

536.514

5284. AN EXAMINATION OF THE 1955 HELIUM VAPOR-PRESSURE SCALES OF TEMPERATURE. E.Ambler and R.P.Hudson.
J. Res. Nat. Bur. Stand., Vol. 57, No. 1, 23-5 (July, 1956).

In a previous communication (Abstr. 6963/1956) magnetic thermometer calibrations in the region 1.3° to 4.2° K were used to examine the internal consistency of two provisional helium vapour-pressure scales of temperature. Since that article went to press, these scales have been made available in their final form, and further measurements have also been made. The results of all the measurements, seven runs in all and with two different apparatuses, are used here to examine the latter scales. The results of six runs were self-consistent and could be reconciled with the empirical scale (T_{55E}) of Clement et al. (Abstr. 292/1956) to within 2 millidegrees, and with the calculated scale of Van Dijk and Durieux (T_{55}) to within 5 millidegrees. The remaining run showed better agreement with T_{55}. It appears, therefore, that the previous assessment of the T_{55} scale may have been a little too favourable. The most critical interpretation of the findings is that the present technique of vapour-pressure measurement is not sufficiently precise to discriminate between the two scales. A.

536.631 : 537.226.2

5285. THE SPECIFIC HEAT OF SEIGNETTOELECTRIC [FERROELECTRIC] CERAMICS. J.Daňková.
Czech. J. Phys., Vol. 6, No. 4, 407-8 (Aug., 1956).

A Nernst vacuum calorimeter is described, with which the specific heat of a tubular sample of Ba/Sr/Ca titanate was measured between liquid air temperature and 140° C. The transition in this sample occurred gradually between −20° and +70° C, the specific heat rising almost linearly in this temperature interval. The permittivity passes through a sluggish maximum in the same temperature region. K.W.Plessner

536.63

5286. CALCULATION OF THE HEAT CAPACITY OF α QUARTZ AND VITREOUS SILICA FROM SPECTROSCOPIC DATA. R.C.Lord and J.C.Morrow.
J. chem. Phys., Vol. 26, No. 2, 230-2 (Feb., 1957).

The heat capacity of α-quartz has been computed over the temperature range 10-700° K, and that of vitreous silica from 10° to 900° K. Debye θ's obtained from the T^3 law below 10° were used for

the "translational" degrees of freedom, and recent infrared and Raman data for the other frequencies. $C_p - C_v$ was negligible for vitreous silica and was computed from compressibility and thermal-expansion data for α-quartz. Agreement with new C_p measurements is excellent for α-quartz (within 1% above 60° K) but is less satisfactory for vitreous silica because of inadequate knowledge of the distribution of frequencies below 500 cm^{-1}. A.

536.631

5287. EFFECT OF IRRADIATION ON THE LOW-TEMPERATURE SPECIFIC HEAT OF GRAPHITE. W.DeSorbo and W.W.Tyler.
J. chem. Phys., Vol. 26, No. 2, 244-9 (Feb., 1957).

The specific heat of heavily irradiated Acheson-type graphite has been measured from 13° to 300° K. Throughout this temperature range, the specific heat of the irradiated graphite is appreciably larger than that of unirradiated graphite of similar type. This difference is explained by assuming that interplanar atoms or clusters of atoms, give rise to modes of low energy which contribute to the specific heat at lower temperatures than do the normal lattice modes. The entropy of the irradiated sample at 298.16° K is 1.492 ± 0.009 cal/g-atom deg compared with 1.372 ± 0.005 cal/g-atom deg for the unirradiated graphite. A.

536.633 : 537.562

5288. EFFECT OF MULTIPLE THERMAL IONIZATION ON THE SPECIFIC HEAT OF GASES. Yu.V.Gaek and B.L.Timan.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 706-7 (1956). In Russian.

The specific heat of gases at high temperatures taking account of single thermal ionization (Abstr. 3698/1955) is here extended to cover multiple ionization. The specific heat is regarded as the sum of the normal thermodynamic C_v and a correction term due to ionization. An expression is derived for the latter which, at high temperatures, is shown to vary markedly with temperature. A graph is given for the variation of the correction term for oxygen over the range of temperatures covering single and double ionization. For temperatures of only a few hundred degrees Celsius the correction term exceeds the un-ionized term. C.R.S.Manders

THERMODYNAMICS 536.7/.8

536.7

5289. THERMODYNAMIC FORMULAS FOR TWO-PHASE SYSTEMS. J.C.M.Li.
J. chem. Phys., Vol. 26, No. 4, 909-13 (April, 1957).

Bridgman's table of thermodynamic formulae or Shaw's table of Jacobians is extended to a two-phase system of one, two, and three components. The present method will include these tables as special cases and can be generalized to any system in a straightforward manner. A.

536.71

5290. EQUATION OF STATE OF WATER TO 250 KILOBARS. M.H.Rice and J.M.Walsh.
J. chem. Phys., Vol. 26, No. 4, 824-30 (April, 1957).

An equation of state for water, applicable in the pressure range 25 kilobars to 250 kilobars, is formulated in terms of experimental data obtained from shock wave measurements. This equation of state is used to calculate P–V relations for several adiabats and isotherms. Thermodynamic and hydrodynamic data along the Hugoniot curve are given as a function of shock pressure, and pressure–particle-velocity relations for initial shocks followed by reflected shocks and rarefactions are given. A.

ELECTRICITY 537

537.122

5291. THE ANOMALOUS MAGNETIC MOMENT OF THE ELECTRON. M.Lévy.
Cahiers de Phys., No. 69, 1-7 (May, 1956). In French.

A review giving an outline of the theory. L.Pincherle

ELECTROSTATICS. DIELECTRICS 537.2

537.211 : 621.3.011.1

5292. A GENERALIZATION OF COULOUMB'S FUNDAMENTAL LAW. B.Konorski.
Arch. Elektrotech. (Berlin), Vol. 42, No. 7, 381-97 (1956). In German.

Coulomb's law on the force of repulsion between two point charges is only approximately true when applied to spheres of finite dimensions, and the degree of approximation is not known. This law is now extended to charged spheres at different potentials and with different charges. Full expressions for the sum of the charges obtained by reciprocal reflection in spherical surfaces are derived, also expressions for the capacitance of systems comprising two spheres, and the forces due to spheres with constant potentials and charges of equal and opposite signs, and the electrostatic equilibrium. The fields are those of insulated or earthed metal spheres. Tables for capacitance coefficients and force coefficients are given. J.Smuts

537.226.1

5293. THE EXISTENCE DOMAIN OF COMPLEX DIELECTRIC CONSTANT OF BINARY MIXTURE. F.Irie.
Ann. Phys. (Leipzig), Vol. 19, No. 1-2, 31-40 (1956).

A theory that gives the existence domain of the complex dielectric constant of the binary mixture for given volume fractions of the components is presented as an extension of O.Wiener's theory. This domain is represented in the complex plane by the overlapped region of two circles. The present theory has the advantage of obtaining the result without any information on the state of mixing, although it does not give a definite value. The correspondence between the point in the domain and the state of mixing is studied. Examples of the application of the theory are given. A.

537.226.1

5294. DIELECTRIC CONSTANT OF DIPOLAR SOLIDS. J.J.O'Dwyer.
J. chem. Phys., Vol. 26, No. 4, 878-9 (April, 1957).

Conflicting formulae for the dielectric constant of a dipolar solid proposed by Frölich and Harris have been critically examined. However, if certain statistical mechanical averages are correctly interpreted, it is shown that Harris' formula reduces to a special case treated by Frölich. A.

537.226.1

5295. A THEORY OF THE DIELECTRIC POLARIZATION OF POLAR SUBSTANCES. A.D.Buckingham.
Proc. Roy. Soc. A, Vol. 238, 235-44 (Dec. 18, 1956).

With the aid of classical statistical mechanics, a general expression for the static dielectric constant is derived. It is found, as in earlier works, that the dielectric constant is dependent upon the mean-square dipole moment of a macroscopic spherical sample of the substance. This mean-square moment is expanded as a series in powers of the mean molecular polarizability, and the terms proportional to the zero and first powers are evaluated in detail and in such a way that the long- and short-range effects are separated. The former are determined with the aid of macroscopic arguments, so that a purely molecular theory remains. In the limit when short-range directional forces are zero, the formula reduced to the well-known Onsager equation. It is found that it is not in general legitimate to replace the surroundings of a macroscopic sample by a continuum having the bulk properties of the substance, and for this reason the approximate equation of Harris and Alder is found to lead to doubtful conclusions. The general equations are applied to the experimental data for water and other liquids, and the results are not unsatisfactory. A.

537.226.2

5296. DIELECTRIC PROPERTIES OF THE MONOCRYSTALS OF ALKALI HALIDES. B.N.Matsonashvili.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1110-11 (1956). In Russian.

Presents the results of an investigation on monocrystals of LiF, NaCl, KCl, KBr, CsBr, KI, "KPC-5" and KCl–KBr (both pure and with admixtures of Ag, Cu, Tl, Cd, Pb and In) conducted at from −170 to 330° C and 10^3-10^7 c/s under atmospheric pressure and at from −140 to 550° C and 10^2-10^6 c/s in a vacuum. The specimens whose capacity attained 70-200 pF were clamped between plane pure Fe electrodes. Relaxation maxima were found in the $\tan\delta$/temperature and $\tan\delta$/frequency curves for all non-heat-treated specimens, i.e. one maximum, as a rule, for pure crystals, and up to four maxima for crystals with admixtures. The maxima disappeared after the

crystals had been heat-treated at a high temperature. For some crystals with admixtures a kink in the ln γ/temperature curve (γ is the electric conductivity) was observed near 200°C. The energy of activation of various crystals, as calculated from the tan δ curves, was 0.7-1.0 eV. An explanation of the appearance of relaxation losses in the crystals tested is proposed. F.Lachman

537.226.2

5297. ELECTRIC SUSCEPTIBILITY OF ETHYL CHLORIDE IN THE CENTIMETRE REGION. G.P.Srivastava.
Z. Phys., Vol. 148. No. 2, 242-7 (1957).

Electric susceptibility of ethyl chloride has been determined in the microwave region at 8780 Mc/s over a pressure range of 10 cm to 75 cm of mercury, and a temperature range of 263°K to 353°K. It has been found that the total susceptibility, at constant temperature, varies almost linearly with pressure. The contribution due to quantised transitions to total susceptibility has been calculated from the data on absorption measurements and it is found to be 0.45×10^{-3}. Since most of this contribution is due to zero frequency transitions, no measurable dispersion is observed in this region. It has been found possible to determine the values of dipole moment and the sum of atomic and electronic polarizations from the data on temperature variation of susceptibility. The values are $\mu = 2.06 \times 10^{-18}$ e.s.u. and $(P_A + P_E) = 22.70$. These results are in fair agreement with those obtained earlier. A.

537.226.2 : 548.736.4

5298. STRUCTURE AND PHASE TRANSITIONS OF FERROELECTRIC SODIUM–LEAD NIOBATES AND OF OTHER SODIUM NIOBATE TYPE CERAMICS. M.H.Francombe and B.Lewis.
J. Electronics, Vol. 2, No. 4, 387-403 (Jan., 1957).

A structural and dielectric study of ceramics based on sodium niobate has shown that solid solutions of perovskite type are formed between $NaNbO_3$ and $PbNb_2O_6$ up to a limit of about 35% replacement of sodium atoms by lead atoms and vacancies. A new ferroelectric tetragonal phase is introduced immediately below the Curie temperature. At lower temperatures the ferroelectric properties become weaker and the structure is orthorhombic with a multiple unit cell of the type found with $NaNbO_3$. For compositions in which more than 25% of the sodium atoms are replaced the room temperature structure is tetragonal. Compositions near the limit of solid solution possess a simple monomolecular perovskite-type cell. Partial substitution of niobium by tantalum lowers the ferroelectric transition temperatures. Comparison of the properties of $NaNbO_3$ with those of solid solutions with $PbNb_2O_6$, $CdNb_2O_6$ and $KNbO_3$ shows that multiple cell effects can be ascribed to puckering of the niobium–oxygen framework, and depend primarily on lattice spacing and packing. The Curie temperature appears to be determined by characteristics of the replacement atom other than its size. The structure below the Curie temperature depends on the puckering and on the nature of the ferroelectric and antiferroelectric coupling. A.

537.226.2

5299. NEW FERROELECTRIC CRYSTAL CONTAINING NO OXYGEN. R.Pepinsky and F.Jona.
Phys. Rev., Vol. 105, No. 1, 344-5 (Jan. 1, 1957).

Crystals of $(NH_4)_2BeF_4$, which are isomorphous with ammonium sulphate, become ferroelectric below −100°C, where an anomaly in the permittivity occurs. The spontaneous polarization at −110°C is 0.19 μ coulomb/cm^2 and the coercive field is 500 V/cm. K.W.Plessner

537.226.2

5300. DELAY-EFFECT IN FERROELECTRIC TITANATES BELOW THE CURIE POINT. Z.Pająk, F.Kaczmarek and J.Jastrzębski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 7, 457-60 (1956).

The change in permittivity of both ceramic and single-crystal barium titanate on applying a d.c. bias field was measured during the first few milliseconds, using an oscillographic technique. Both the application and the removal of the field caused an immediate increase in permittivity, followed by a gradual decay. Over a longer period of time this decay led to a reduced permittivity with the field applied and to the original value with the field removed. The delay is attributed to imperfections in the crystal lattice. K.W.Plessner

537.226.2

5301. ELECTROSTATIC CONSIDERATIONS IN $BaTiO_3$ DOMAIN FORMATION DURING POLARIZATION REVERSAL. R.Landauer.
J. appl. Phys., Vol. 28, No. 2, 227-34 (Feb., 1957).

Merz's picture of spike-shaped domains of reversed polarization emerging from an electrode is analysed with particular attention to its electrostatic aspects, taking into account the inhomogeneous piezoelectric distortions which accompany domain formation. The depolarization energy of a domain is evaluated. The interaction energy of the applied field and the depolarization field is shown to b negligible. The charge flowing into the electrodes as a domain expands is shown to be related primarily to the reversal of spontane ous polarization, rather than to the changes of the depolarization field. Final results are similar in form to the expression originall given by Merz. Although a detailed domain wall theory is not yet available, an existing domain wall estimate has been combined with the electrostatic expressions, and this results in an implausibly lar critical nucleus. Some effects of nonlinearities in the dielectric behaviour and of internal charge distributions are discussed. A

537.226.2 : 548.52

TITANATE CRYSTAL PROPERTIES. See Abstr. 4857

537.226.2 : 548.52 : 548.736

DIELECTRIC CONSTANT OF $SrTiO_3$. See Abstr. 4907

537.226.2 : 536.63

Ba–Sr–Ca TITANATE PERMITTIVITY. See Abstr. 5285

537.226.3 : 537.312.

5302. INFLUENCE OF THE PHYSICAL STATE AND OF INFRARED IRRADIATION ON THE RADIOFREQUENCY DIPOLAR ABSORPTION OF VERY PURE SPECIMENS OF HEXAGONAL SELENIUM. J.Meinnel, M.Eveno and F.Trigolet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1761-4 (Nov. 26, 1956). In French.

Though vitreous Se shows no dielectric loss from 50 c/s to 50 Mc/s ϵ'' may rise to 0.5 for hexagonal crystals in the dark. From the temperature displacement of the absorption bands the activation energy is 0.16 eV and 0.24 eV for material crystallized at 478°K and 383°K respectively. Simultaneous irradiation with infrared radiation shifts the dielectric loss maximum to higher frequencies; there is a threshold at 1.4 μ and the shift increases to a local maximum with 1.1 μ radiation and a larger maximum at 0.7 μ which causes a shift of loss frequency maximum of 8 times. The shift expressed as $\log \nu_\lambda - \log \nu_{dark}$ increases linearly with infrared power. The effect takes 1/2 hr of irradiation to establish and is related to electron traps. D.H.Whiffe

537.226.

5303. ON THE EXISTENCE, FOR ZINC OXIDE, OF SEVERAL DISTINCT MECHANISMS OF DEBYE DIPOLE ABSORPTION. M.L.Blanchard.
C.R. Acad. Sci. (Paris), Vol. 244, No. 6, 767-70 (Feb. 4, 1957). In French.

Previous difficulties in the interpretation of the high-frequency absorption of ZnO are resolved if five distinct mechanisms are con sidered, resulting from traces of water, cations, or the previous heat treatment. C.A.Hogart

537.226.3 : 548

5304. THEORY OF DIELECTRIC RELAXATION FOR THE THREE-DIMENSIONAL POLAR ROTATOR: LATTICE MODELS LEADING TO BIMODAL LOSS CURVES. J.D.Hoffman and B.M.Axilrod.
J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 61-73 (Feb., 1957).

The characteristics of the dielectric relaxation spectrum ass ciated with some simple three-dimensional lattices consisting of p lar molecules of specified shape have been investigated with the o ject of determining whether dielectric loss curves with two distinc maxima (bimodal loss curves) could be predicted on a theoretical basis for such systems. For the types of lattice and molecular shape considered, each dipole has one stable and four meta-stable orientations. The calculations show that under certain circumstan es bimodal loss curves may arise for pear-shaped molecules in both the body-centred orthorhombic and tetragonal systems. All the models lead to a single loss peak if the barrier system is suffi iently isotropic as in the body-centred cubic lattice. The changes with temperature of the shape of the loss curves, the static dielec ric constant, and the configurational entropy are discussed. The abrupt changes in these properties that will occur at phase trans itions due to cooperative interaction are also considered. Qualita ive predictions concerning the expected behaviour of bimodal loss curves for three-dimensional lattices, in which each dipole has on a single stable orientation, are compared with experiment. Using an argument based on the fact that broadened loss curves in monoc phase molecular crystals become narrower with increasing tempe ature, it is concluded that fluctuations of structure are not the pri cipal cause of the broadening of loss curves. The present theory leads to the correct type of temperature dependence, and this strengthens the view that the origin of multiple relaxation times i molecular crystals is the anisotropy of the crystalline field.

537.226.32

5305. EXPERIMENTS ON THE POLARIZATION AND DECAY OF ELECTRETS. G.G.Wiseman and G.R.Feaster.
J. chem. Phys., Vol. 26, No. 3, 521-7 (March, 1957).

Experiments have been performed to test implications of a two-charge theory of electrets. It was found that the persistent volume polarization of a number of dielectrics can be expressed by analytical functions which are linear in the applied field and exponential in time. The linear superposition of the effects of homocharge and heterocharge is demonstrated for some dielectrics and is shown to be violated for another, Lucite. The heterocharge and homocharge are demonstrated to be different but interacting entities, their interaction being given by the static field equations for a three-layer capacitor. A major cause of electret decay is shown to be the self-depolarization of the electret by its own electric field. A.

537.226.32 : 537.311.32

ELECTRICAL CONDUCTIVITY OF CARNAUBA WAX NEAR ITS MELTING POINT. See Abstr. 4322

537.226.33

5306. RELAXATION PROCESSES AND INERTIAL EFFECTS. I. FREE ROTATION ABOUT A FIXED AXIS. R.A.Sack.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 402-13 (April, 1957).

The limitations of the usual concepts of relaxation processes for very short periods are discussed, and it is shown that in the limit of very high frequencies the product of the loss factor and frequency must tend to zero. For a consistent kinetic treatment the probability must be considered in phase space, not merely in configuration space; for Cartesian coordinates the stochastic (generalized Liouville) equations can be simplified by a Fourier transformation with regard to the velocities. By means of the simplified equations the dielectric properties are determined for a system of rigid dipoles rotating about fixed axes in a viscous medium. The results are equivalent to, but more compact than, those derived for the same problem by E.P.Gross (Abstr. 2580, 8733/1955); for strong viscuous damping they agree with Debye's relaxation formulae, except at very high frequencies. The polarization can be described by an infinite discrete set of relaxation times with amplitudes which alternate in sign; the longest relaxation time is identical with that calculated by Debye. The logarithm of the function expressing the dielectric after-effect follows a law similar to the Ornstein—Fürth generalization of Einstein's law of diffusion. The analytical solutions obtained by Gross for abrupt collisions between dipoles and heat-bath are also re-derived by a somewhat easier method. A.

537.226.33

5307. RELAXATION PROCESSES AND INERTIAL EFFECTS. II. FREE ROTATION IN SPACE. R.A.Sack.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 414-26 (April, 1957).

For Pt I, see preceding abstract. The calculations of the effect of inertia on the dielectric properties of systems of identical non-interacting rigid dipoles with various types of fluctuation are extended to the case of free rotation in space. The equations of motion, and hence the stochastic equations, depend on all three moments of inertia; the dumb-bell and the spherical top models are treated in detail. The probability distribution in phase space is conveniently replaced by a distribution in configuration—velocity space which simplifies the fluctuation terms, but necessitates a modification of the Liouville equation. The response of the polarization to an alternating electric field can be expressed in terms of continued fractions similar to the solution obtained by E.P.Gross (Abstr. 8733/1955) for the plane rotation model. For all collision mechanisms which leave the orientation of the dipoles unaltered the second approximation yields a modification of Debye's relaxation formula which has previously been derived by Powles and by Gross; the precise nature of the model affects the result only in higher approximation. The relation of the exact solutions and several approximate formulae is discussed and a misprint in a formula by Rocard is pointed out. For fluctuations of the Brownian movement type the frequency response of the dumb-bell model tends towards that of a damped harmonic oscillator as the viscosity decreases. For abrupt collisions the results can be expressed in an analytic form. A.

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.2

5308. MEASUREMENT OF DEVIATIONS FROM OHM'S LAW AND OF THE FLICKER EFFECT EXHIBITED BY VERY THIN FILMS OF SILVER, GOLD, AND ALUMINIUM. C.Uny and N.Nifontoff.
C.R. Acad. Sci. (Paris), Vol. 244, No. 6, 729-32 (Feb. 4, 1957). In French.

Deviations from Ohm's law seem to be associated with deviations of noise power in the 1000 to 5000 c/s range from the usual law $\overline{\epsilon_\nu^2} = K(I^2/\nu)$ where ν is frequency and I is current. For Al films the noise power is lower than for films of Au and Ag.
C.A.Hogarth

537.311.31 : 538.632

5309. MEASUREMENTS OF THE HALL EFFECT IN DIAMAGNETIC METALLIC ALLOYS OF PALLADIUM. J.Cohen.
C.R. Acad. Sci. (Paris), Vol. 243, No. 16, 1105-7 (Oct. 15, 1956). In French.

By successively alloying with varying amounts of Re, Ag, and Ti, the Hall effect is reduced, and presumably the free electron concentration is increased. It is suggested that the additional free electrons introduced are not available for magnetic coupling.
C.A.Hogarth

537.311.31

5310. THE ELECTRICAL RESISTANCE OF COPPER—ALUMINIUM ALLOYS. G.Darmois and S.Janssen.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1496-9 (Nov. 12, 1956). In French.

Reports results of measurements of the temperature variation of the resistivity ρ of two alloys (11.4% and 14.5% Al) up to 1000° C. For the 11.4% alloy ρ decreases rapidly at 650° C due to the effects of a solubility limit. E.P.Wohlfarth

537.311.31 : 537.533.2

5311. REPLY TO THE CRITICAL REMARKS OF I.F.KVARTSKHAVA CONCERNING OUR PAPERS. G.V.Lebedev.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 144-6 (1957). In Russian.

Reply to Kvartskhava's criticism (Abstr. 358/1957) of the work of Lebedev et al. (Abstr. 960, 1018, 4765, 6123, 6257/1955).

537.311.33

5312. DESCRIPTIVE THEORY OF SEMICONDUCTORS. E.L.Steele.
Amer. J. Phys., Vol. 25, No. 3, 174-9 (March, 1957).

A nonmathematical description of the basic ideas and concepts underlying the field of semiconductors and semiconductor devices is given here. The role of the energy band scheme, of the impurity donor and acceptor atoms, and of the p—n junction in semiconductor device physics is discussed in detail. The nonsymmetrical conduction or rectification properties of the p—n junction, which determine such things as forward and reverse voltage—current relationships, are qualitatively treated. The p—n junction theory is then extended to the physics of transistor action and to a discussion of the fundamental parameters which enter into transistor behaviour. A.

537.311.33 : 535.377 : 537.583

5313. ELECTRONIC CONDUCTIVITY, THERMOLUMINESCENCE AND THERMIONIC EMISSION IN IONIC CRYSTALS. J.Kantůrek.
Czech. J. Phys., Vol. 6, No. 4, 349-58 (Aug., 1956). In German.

The variation with time of these phenomena were studied in fluorspar coloured by X-irradiation. Kinetic equations are established describing the phenomena, and are used to explain the displacement of the luminescence maximum from the maximum of emission and conductivity. B.T.M.Willis

537.311.33 : 541.57

5314. RECOGNITION AND CLASSIFICATION OF SEMICONDUCTING COMPOUNDS WITH TETRAHEDRAL sp^3 BONDS. E.Mooser and W.B.Pearson.
J. chem. Phys., Vol. 26, No. 4, 893-9 (April, 1957).

See Abstr. 8181 (1956). The use of this concept is extended to give a systematic classification of a large group of compounds in which the well known sp^3 tetrahedral bonds occur and whose structures are closely related to the zinc blende and wurtzite lattices. This treatment has led to the discovery that many compounds, whose electrical properties have not previously been examined, are semiconductors. A.

537.311.33 : 548.7

5315. THE EFFECT OF FREE ELECTRONS ON LATTICE CONDUCTION AT HIGH TEMPERATURES. R.Stratton.
Phil. Mag. (Eighth Ser.), Vol. 2, 422-2 (March, 1957).

It is shown that, while phonon—electron scattering in a semiconductor can be of importance at low temperatures, it is relatively unimportant above the Debye characteristic temperature.
P.T.Landsberg

537.311.33 : 538.61

5316. INTERBAND MAGNETO-OPTIC EFFECTS IN SEMICONDUCTORS. E.Burstein and G.S.Picus.
Phys. Rev., Vol. 105, No. 3, 1123-5 (Feb. 1, 1957).

Previous studies on InSb have been extended to higher photon energies. For magnetic fields as low as 15 000 Oe the intrinsic absorption spectrum exhibits several prominent peaks attributed to vertical optical transitions between magnetic sub-bands of the light-hole valence band. Similarities and differences between the I.M.O. (interband magneto-optic effect) and cyclotron resonance experiments are discussed. C.A.Hogarth

537.311.33 : 537.312.8

5317. D.C. MAGNETOCONDUCTIVITY AND ENERGY BAND STRUCTURE IN SEMICONDUCTORS. R.M.Broudy and J.D.Venables.
Phys. Rev., Vol. 105, No. 6, 1757-63 (March 15, 1957).

A general method is described for experimentally obtaining all components of the magnetoresistivity tensor; thence the components of the magnetoconductivity tensor ($\mathfrak{L}$) can be computed. The method is specialized to cubic materials to obtain $\mathfrak{L}(\phi)$, where ϕ is the angle between H and the [001] direction in a (100) plane. Mass tensor theory has been developed into a convenient form and applied to this experiment for the three spheroidal cases. Expressions for determination of the mass ratio (K) have been derived. The experiment has been performed on n-type germanium and silicon, verifying the known band structures by means of the angular dependence of $\mathfrak{L}(\phi)$. K has been determined for germanium from 65°K to 200°K. A.

537.311.33

5318. RADIATIVE TRANSITIONS IN SEMICONDUCTORS. H.J.Bowlden.
Phys. Rev., Vol. 106, No. 3, 427-31 (May 1, 1957).

A multicomponent formalism similar to that of Adams (Abstr. 1072/1954) is developed and applied to the calculation of transition matrix elements. The problem of the perturbed periodic potential is treated in the Bloch representation in such a way that the wave-functions may be expressed in explicit form. First-order corrections to the effective mass theory are obtained, and matrix elements for radiative intraband and allowed and forbidden interband transitions are presented. A.

537.311.33 : 538.6

5319. THE GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS IN SEMICONDUCTORS. R.Mansfield.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 240-3 (Feb., 1957).

A rigorous calculation as regards the relaxation-time–energy relationship for the case of charge carriers scattered by ionized impurity centres. The Nernst coefficient is also evaluated for a transition from lattice to impurity scattering. K.W.Plessner

537.311.33

5320. FLUCTUATIONS IN THE NUMBER OF ELECTRONS AND HOLES IN A SEMICONDUCTOR. D.J.Oliver.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 244-7 (Feb., 1957).

Results are obtained for degenerate semiconductors using a statistical mechanical method. The case of InSb is treated as an example and it is found that in this case the results agree closely with those derived by Burgess (Abstr. 8750/1955). K.W.Plessner

537.311.33

5321. CYCLOTRON RESONANCE. V.N.Lazukin.
Uspekhi fiz. Nauk, Vol. 59, No. 3, 553-82 (1956). In Russian.

The term is applied to transitions between the various energy states of the charge carriers in a magnetic field induced by the electric vector of the electromagnetic field acting on the charge, during coincidence of the frequency of this field with the frequency of rotation of the charge about H. This implies a mechanism of absorption of h.f. energy by the charged particle, similar to that which occurs in a cyclotron. The topic is here discussed for an electron gas and for semiconductors including n-type resonance in the conduction zone of Ge and Si and p-type resonance in the valency zone of Ge and Si. Experimental methods are also discussed. 43 refs.(one-third in Russian). C.R.S.Manders

537.311.33 : 539.234

5322. PREPARATION AND ELECTRICAL PROPERTIES OF THIN FILMS OF BISMUTH. A.Colombani and P.Huet.
C.R. Acad. Sci. (Paris), Vol. 244, No. 6, 755-8 (Feb. 4, 1957). In French.

To obtain stable properties, evaporated films of bismuth were heated in vacuum. Heating to 220° C gave reproducible resistivity values, but the Hall constant varied from film to film. Heating to beyond the melting point, 270° C, was possible only if the film was prepared between two layers of bismuth oxide; without this the film broke up into islands. Vacuum-melted films show reversible properties for temperatures up to 320° C. At the melting point the ratio of solid to liquid resistivity is 2.5, the same as for the bulk metal. C.Hilsum

537.311.33 : 539.234

5323. CHANGE OF RESISTANCE WITH TEMPERATURE OF THIN BISMUTH FILMS. P.Huet and A.Colombani.
C.R. Acad. Sci. (Paris), Vol. 244, No. 7, 865-8 (Feb. 11, 1957). In French.

Vacuum-melted films, prepared between bismuth oxide layers (see preceding abstract), have semiconducting properties for thicknesses less than 200 A. Films thicker than 2200 A are metallic with a resistivity of 200×10^{-6} ohm-cm. Films of intermediate thickness have a negative temperature coefficient of resistance up to a transition temperature, and a positive coefficient at higher temperatures. The transition temperature decreases with thickness, and is 20° C for a thickness of 2200 A. C.Hilsum

537.311.33

5324. ELECTRICAL PROPERTIES OF Cd–Sb. T.Miyauchi and H.Kimura.
J. Phys. Soc. Japan, Vol. 11, No. 9, 1013-14 (Sept., 1956).

Conductivity and Hall effect studies up to 280° C are reported for p-type specimens. Ionic conduction is important above 300° C. Room temperature hole mobility is 1100 ± 200 cm^2 volt^{-1} sec^{-1}, hole effective mass is 0.1 to 0.2 m_e; energy gap is 0.3 ± 0.05 eV; room temperature resistivity is approximately 0.1 ohm cm. C.A.Hogarth

537.311.33

5325. EXPERIMENTAL EVIDENCE OF THE ANISOTROPY OF HOT ELECTRONS IN N-TYPE GERMANIUM. W.Sasaki and M.Shibuya.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1202-3 (Nov., 1956).

Nonohmic currents in the (110) plane, at angles of 0, 25 and 65° from the cubic axis, were observed for three samples at 90°K. The transverse electric fields developed by half-microsecond pulses which gave fields of up to 10^3 V/cm in the current direction were measured and found to be in agreement with previous calculations (Abstr. 8748/1955) based on the model of spheroidal energy surfaces in the conduction band. R.Stratton

537.311.33

5326. OSCILLATORY MAGNETO-ABSORPTION OF THE DIRECT TRANSITION IN GERMANIUM. S.Zwerdling and B.Lax.
Phys. Rev., Vol. 106, No. 1, 51-2 (April 1, 1957).

Infrared transmission of intrinsic germanium was examined at wavelengths from 1.4 μ to 1.6 μ in constant magnetic fields up to 36 000 gauss. The magneto-absorption showed oscillatory behaviour at photon energies greater than that of the direct transition. The energy gap of the direct transition was determined experimentally to be 0.803 ± 0.001 eV at room temperature. The effective mass of the electron in the Γ_2^- conduction band was found to be $\cong 0.042 m_0$. Anisotropy of the oscillations was observed as a function of the orientation of the sample in the magnetic field. A.

537.311.33 : 537.312.7

5327. FIELD EFFECT IN GERMANIUM AT HIGH FREQUENCIES. H.C.Montgomery.
Phys. Rev., Vol. 106, No. 3, 441-5 (May 1, 1957).

Changes in conductivity near the surface of germanium in response to an a.c. electric field have been investigated at frequencies as high as 50 Mc/sec for both n- and p-type material, and in wet air, dry oxygen, and ozone ambients. In certain ambients the sign of the field effect changes at a frequency closely related to the reciprocal of the minority carrier lifetime. At higher frequencies the field effect mobility is sometimes substantially larger than bulk mobility of the majority carrier. A model is suggested which is in harmony with most the experimental observations. A.

537.311.33

5328. SURFACE ELECTRICAL CONDUCTION OF GERMANIUM. V.I.Lyashenko and T.N.Sitenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 905-7 (1956). In Russian.

A thin Ge plate was made one side of a capacitor (~ 50 μ mica dielectric) and the effect of ±2 kV applied voltage on the electrical properties of the plate was studied. With the Ge negative conductivity and Hall mobility decreased, with the Ge positive the reverse occurred. These results were interpreted in terms of surface conduction. C.H.L.Goodman

537.311.33 : 538.63

5329. OSCILLATORY GALVANOMAGNETIC EFFECTS IN N-TYPE INDIUM ANTIMONIDE. Y.Kanai and W.Sasaki.
J. Phys. Soc. Japan, Vol. 11, No. 9, 1017-18 (Sept., 1956).

These effects were measured from room temperature down to 1.3° K. Graphs are shown of magnetoresistance as a function of field strength, from 0 to 10 kilogauss, for transverse, 45°, and longitudinal effects; in each case there is a peak at about 1 kilogauss, a minimum at 2 kilogauss, followed by a monotonic increase. The Hall coefficient has a maximum at 1 kilogauss and a minimum at 2 kilogauss. These measurements were made on a single crystal.

N.Corcoran

537.311.33

5330. THEORY OF THE SPECTRAL DISTRIBUTION OF RECOMBINATION RADIATION FROM InSb. T.S.Moss.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 247-50 (Feb., 1957).

The theory, which takes into account internal reflections and internal absorption, is in good agreement with experimental observations. It is deduced that about 20% of all recombinations are radiative.

K.W.Plessner

537.311.33

5331. CURRENT NOISE IN INDIUM ANTIMONIDE. D.J.Oliver.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 331-2 (March, 1957).

No excess above Johnson noise could be detected on passing currents up to 0.5 A through InSb filaments 1mm^2 in cross-section. Measurements were made in a frequency range from 20 c/s to 20 kc/s. A comparison is made with germanium.

C.Hilsum

537.311.33

5332. ON A CARRIER SCATTERING MECHANISM IN LEAD TELLURIDE. L.S.Stil'bans, B.I.Bok and É.L.Lifshits.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 1011-13 (1956). In Russian.

Theoretically, the mobility in an atomic semiconductor varies as $T^{-3/2}$ but recent observations, particularly in PbS, PbSe and PbTe have revealed a $T^{-5/2}$ law. If the mean free path of an electron is assumed to be proportional to ϵ^r/T, where ϵ is its energy, then $r = 1$, which contradicts the theory for atomic semiconductors ($r = 0$). It is deduced from measurements of thermoelectric power and Hall constant on a wide range of samples of PbTe that r must, in fact, be zero. A mechanism is suggested which is compatible with a $T^{-3/2}$ law at low temperatures, changing to $T^{-5/2}$, or even $T^{-7/2}$, at high temperatures. This involves the increasing probability of double or triple phonon collisions as the temperature rises.

J.B.Arthur

537.311.33

5333. MECHANISM OF CONDUCTION IN Li-SUBSTITUTED TRANSITION METAL OXIDES. R.R.Heikes and W.D.Johnston.
J. chem. Phys., Vol. 26, No. 3, 582-7 (March, 1957).

A study of the effect of Li substitution on the electrical properties of the oxides MnO, CoO, NiO, and CuO has been made. It has been found that (1) the activation energy for conduction increases abruptly near the antiferromagnetic Curie point; (2) as Li is added the activation energy and resistivity initially decrease rapidly and then level off in the neighbourhood of 2% substituted Li; (3) this initial decrease becomes progressively greater in going from MnO to CuO in the sequence of the periodic table. A rather complete understanding of these materials can be had by treating the conduction process as a thermally activated diffusion of positive holes which are trapped by the local strain induced by their own polarization field. The magnitude of the activation energy will be related to the work done against elastic forces necessary to reduce the local strain at a positive hole to zero.

A.

537.311.33

5334. THE ELECTRICAL PROPERTIES OF THE INTERMETALLIC COMPOUNDS Mg_2Si, Mg_2Ge, Mg_2Sn, and Mg_2Pb. U.E.Winkler.
Dissert. E.T.H. Zürich, No. 2501, 633-66 (1955). In German.

Gives detailed results of measurements of the electrical conductivity, the Hall effect, and the thermoelectric effect on polycrystalline specimens of these intermetallic compounds prepared by direct melting. Measurements were made over the temperature range 100-1100 °K and the results show that Mg_2Si, Mg_2Ge, and Mg_2Sn behave as true semiconductors whilst the results for Mg_2Pb indicate that this compound is a strongly degenerate semiconductor. Particulars of the electrical constants of these compounds are given.

A.E.De Barr

537.311.33

5335. INTERNAL FIELD EMISSION IN SILICON P–N JUNCTIONS. A.G.Chynoweth and K.G.McKay.
Phys. Rev., Vol. 106, No. 3, 418-26 (May 1, 1957).

Internal field emission is believed to occur in narrow p–n junctions in silicon. This conclusion is based on the following observations: (i) as in wide junctions, the multiplication characteristic has a positive temperature coefficient whereas the reverse characteristic, unlike wide junctions, possesses a negative temperature coefficient; (ii) the forward and reverse currents are relatively insensitive to temperature; (iii) radiative transitions of energetic carriers in the high-field region result in the emission of visible light, the pattern of which shows that the current flows more or less uniformly through the whole extent of the junction but that the array of fewer and more intense light spots characteristic of avalanche breakdown is absent; (iv) the noise associated with the onset of avalanche breakdown is absent. It is concluded that in these narrow junctions the junction space-charge field due to the built-in potential alone is sufficient to result in a rate of carrier generation much greater than that of the normal thermal processes. By assuming a reasonable form for the voltage dependence of the field-generated current, it proves possible to account qualitatively for the complex forward-bias characteristics of these junctions. The reverse characteristics show the onset of multiplication of field-emitted carriers at a reasonable threshold. Possible causes of the softness of the reverse characteristics are discussed.

A.

537.311.33

5336. SURFACE STATES ON SILICON AND GERMANIUM SURFACES. H.Statz, G.DeMars, L.Davis, Jr and A.Adams, Jr.
Phys. Rev., Vol. 106, No. 3, 455-64 (May 1, 1957).

Interface states are found in the upper half of the energy gap of silicon and germanium. On weakly oxidized surfaces, they lie 0.42 and 0.13 eV above the intrinsic position of the gap with approximate densities 10^{11} to 10^{12} and 10^{10} to 10^{11} for silicon and germanium respectively. On well-oxidized surfaces, interface states are found approximately 0.44 to 0.48 eV and 0.18 eV above the intrinsic position of the gap with densities of around 10^{12} and 10^{11} to 10^{12} for silicon and germanium, respectively. At large bias voltages, high electric fields exist in the oxide film. Changes in the structure of the interface states in the upper half of the gap of silicon are found. A model is given which can account for the experimental observation.

A.

537.311.33

5337. SEMICONDUCTING PROPERTIES OF SOME VANADATE GLASSES. P.L.Baynton, H.Rawson and J.E.Stanworth.
J. Electrochem. Soc., Vol. 104, No. 4, 237-40 (April, 1957).

Glasses have been made in the systems $BaO–V_2O_5–P_2O_5$ and $Na_2O–BaO–V_2O_5–P_2O_5$ with V_2O_5 contents ranging between 59 and 87 mole %. The glasses were found to be semiconductors, those with the highest V_2O_5 contents having a specific conductivity of the order of 10^{-5} ohm^{-1} cm^{-1} at room temperature. The relationship between the specific conductivity, σ, and the temperature was determined, and it was found that the slope of the log σ–1/T plots was equivalent to an activation energy in the range 0.35-0.40 eV for all the glasses. The value of log σ at 25° C plotted against the mole % V_2O_5 gave a straight-line relationship for each series of glasses. Conductivity values obtained could be easily reproduced and were not sensitive to variations in melting conditions.

A.

537.311.33

5338. ELECTRICAL PROPERTIES OF PHTHALOCYANINES. P.E.Fielding and F.Gutman.
J. chem. Phys., Vol. 26, No. 2, 411-19 (Feb., 1957).

The electrical conductivity of single crystal of metal-free, copper, nickel, and cobalt phthalocyanines were measured over temperature ranges extending from 50° to 390° C. The weighted mean values of the activation energies obtained were: 1.71 eV for the metal-free, 1.60 eV for the cobalt, and for the nickel, and 1.64 eV for the copper substituted compounds. No significant difference in the activation energy of the metal-free compound was observed between directions parallel and perpendicular to the (001) face of the crystal. The results were well reproducible and showed no significant variation for different crystals. It is concluded that these compounds are, above room temperature, intrinsic semiconductors and that the introduction of a metal atom into the molecule produces comparatively little change in the activation energy of conduction. A thermoelectric power of +50 μV/° C was measured for metal-free and for copper phthalocyanine, indicating that the majority carriers are holes. Since the values of the constant σ_0 were found to be in the order of 100 Ω^{-1} cm^{-1} it is concluded that their mobilities are rather low. Optical transmission spectra are reported for these compounds in solutions as well as in the form of thin evaporated films. The energy of the first electronic transition evident in the film spectra agrees with the thermal activation energy for electrical conduction. There is little difference in the positions of the absorption maxima

observed in evaporated films and in solution, although the intensities are altered. The photoconductive response resembles the spectral transmission characteristics of the compounds. The quantum efficiency is low. A.

537.311.33 : 621.314.63

5339. MINORITY-CARRIER STORAGE IN SEMI-CONDUCTOR DIODES. J.C.Henderson and J.R.Tillman.
Proc. Instn Elect. Engrs, Paper 2293R, publ. Jan., 1957 (Vol. 104B, 318-32, 333-6).

Republication, with discussion, of the paper abstracted in Abstr. 2192 (1957).

537.311.33 : 537.312.5

5340. A PULSE METHOD FOR THE STUDY OF PHOTOELECTRIC PROPERTIES OF P–N JUNCTIONS IN GERMANIUM.
Yu.I. Ukhanov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1238-41 (1956). In Russian.

The infrared absorption of Ge in the presence of an electric current was measured at high current densities by the use of pulse modulation of the current (duty cycle 5%). Specimens were prepared from 5 ohm cm single crystal n-type Ge in rectangular rods, 0.3 cm in the current direction, 0.2 cm in the light-beam direction and 0.05 cm thick, with an alloyed p–n junction at one end. In one specimen, a modulation depth of 60% was observed at a current of 2A. A plot of modulation depth against position of light spot gives an exponential decay from which minority carrier lifetime can be obtained. Electroluminescence was observed at forward currents greater than 50 mA. The effect increased with increase in current.

J.B.Arthur

537.311.33

5341. HYDROGEN DOPING AS THE MECHANISM OF ELECTROLYTIC RECTIFICATION. P.F.Schmidt.
J. appl. Phys., Vol. 28, No. 2, 278-9 (Feb., 1957).

It is suggested that the low resistance of electrolytic oxide films when the base metal is negative is due to the migration of protons into the film under the action of the field. Various tests which confirm this theory are described. K.W.Plessner

537.312.5

5342. PbSe AND PbTe INFRA RED DETECTORS. T.Piwkowski.
Acta phys. Polon., Vol. 15, No. 4, 271-4 (1956).

As far as could be ascertained the PbSe photoconductive and photovoltaic layers processed by the evaporation method lose their photoelectric properties when exposed to the atmospheric air. The author developed the method, which gives the PbSe layer the property of maintaining its photoconductive and photovoltaic sensitivities in the atmosphere. PbTe photosensitive layers have also been produced by a similar method. A.

537.312.5

5343. AN ANOMALY IN THE FORWARD AND REVERSE CONDUCTIVITIES OF A SELENIUM PHOTOCELL COOLED TO LOW TEMPERATURE AND REACTIVATED BY INFRARED. G.Blet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1753-5 (Nov. 26, 1956). In French.

537.312.5

5344. RESENSITIZATION OF SELENIUM PHOTOCELLS AT LOW TEMPERATURES BY THE ACTION OF NEAR INFRARED RADIATION. G.Blet.
J. Phys. Radium, Vol. 18, No. 2, 121-7 (Feb., 1957). In French.

The response of selenium barrier-layer photocells decreases markedly as the temperature is lowered, the spectral response also showing changes. Irradiation in the region of about 0.75 μ at low temperatures restores a large fraction of the original room temperature sensitivity. The effect of duration and intensity of the infrared radiation is investigated.

G.F.J.Garlick

537.312.5

5345. EXAMINATION, IN THE PHOTOEMISSION MICROSCOPE, OF METALS SUBJECTED TO MECHANICAL STRESS. R.Goutte, C.Guillaud and R.Arnal.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2026-8 (Dec. 17, 1956). In French.

The photoelectric emission, excited by ultraviolet light, is found to be greater under stress than with unstressed metal, in the case of Au, Ag and Pd foils, the observations being made on a fluorescent screen viewed by a microscope, and the foils being kept in vacuo before and during the application of stress. J.Thewlis

537.312.5

5346. EXCITON STRUCTURE OF SPECTRAL CURVES OF THE INTERNAL PHOTOEFFECT IN CRYSTALS.
E.F.Gross, A.A.Kaplyanskiĭ and B.V.Novikov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 5, 761-4 (1956). In Russian.

A study of the photoconductive response of HgI_2 and CdS crystals to polarized light at low temperatures at wavelengths near their main at optical absorption edges. Peaks in response could be matched with peaks in optical absorption for certain relative alignments of crystal axis and light vector. This was claimed as evidence for an exciton mechanism of photocurrent generation (see also Abstr. 8804/1956, 403/1957). The effect of long-wave background radiation on the peak photoconductive response was small for HgI_2 but large for CdS. This was being further investigated. C.H.L.Goodman

537.312.5

5347. EFFECT OF MECHANICAL CONSTRAINTS ON THE PHOTOELECTRIC EMISSION OF POLYCRYSTALLINE METALLIC SUBSTANCES. R.Bernard, C.Guillard and R.Goutte.
J. Phys. Radium, Vol. 17, No. 10, 866-71 (Oct., 1956). In French.

Photoelectric emission from gold, palladium, aluminium and other metals is increased by plastic deformation of the specimens. The effect is reversible for elastic deformation. See also Abstr. 5395 (1957). G.F.J.Garlick

537.312.5

5348. PHOTOCONDUCTION OF SILVER CHLORIDE CRYSTALS.
N.Itoh and T.Suita.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1124-5 (Oct., 1956).

Photocurrents I were measured under rectangular voltage impulses V of 200 μsec duration, up to 600 volts amplitude and results compared with calculated I–V curves for specimens of different thickness. Results suggest action of space charge lowers effective field strength in thinnest specimens. C.G.Morgan

537.312.

5349. INVESTIGATION OF THE PHOTOCONDUCTIVE EFFECT IN LEAD SULFIDE FILMS USING HALL AND RESISTIVITY MEASUREMENTS. J.F.Woods.
Phys. Rev., Vol. 106, No. 2, 235-40 (April 15, 1957).

A long-standing question in the theory of photoconductivity in semiconductor films is whether the change in conductivity can be attributed completely to a change in carrier density, or whether current amplification occurs through modulation of barrier potentials. This question is studied in chemically deposited films of lead sulphide by measuring the fractional change in Hall coefficient, $\Delta R_H/R_H$, and the fractional change in resistivity, $\Delta\rho/\rho$, under illumination. The measurements were made over the temperature range -41°C to $+31^\circ$C. It was found that $\Delta R_H/R_H = (\Delta\rho/\rho)(1 \pm 0.06)$ in this temperature range. Expressed in terms of the Hall mobility $\mu_H = R_H/\rho$, the result is that $\Delta\mu_H/\mu_H = 0 \pm 0.06\ \Delta\sigma/\sigma$. A model of photoconductivity is considered, which assumes that the primary photoeffect is a change in the density of majority carriers in the PbS crystallites and that secondary barrier amplification effects can occur by trapping of minority carriers at the intercrystalline barriers. Application of the result, $\Delta\mu_H/\mu_H = 0$, to this model leads to the conclusion that photoconductivity in chemically deposited lead sulphide films can be accounted for by changes in majority carrier concentration in the PbS crystallites; no barrier amplification occurs.

537.312.

5350. PRIMARY PHOTOCURRENT IN CADMIUM SULFIDE.
P.J.van Heerden.
Phys. Rev., Vol. 106, No. 3, 468-73 (May 1, 1957).

Experiments were performed on the photocurrent caused by short flashes of light and by individual α-particles in high-resistivity cadmium sulphide crystals. It was shown that the photocurrent pulses could be described by the mechanism of the so-called primary photocurrent of both electrons and "holes". The energy lost by an α-particle per electron-hole pair created was found to be 7.2 eV, which seems somewhat high. Efforts to correlate the primary photocurrent with the so-called edge luminescence were not successful.

A

537.312

5351. A SINGLE CRYSTAL PHOTODIODE OF LEAD SULPHIDE.
J.Starkiewicz, G.Bate, H.Bennett and C.Hilsum.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 258-9 (Feb., 1957).

Photovoltaic cells were made by heating p-type lead sulphide single crystals in vacuum to convert the surface to n-type conductivity, and evaporating gold electrodes on to the two regions. A typical cell, area 8 mm^2, has response out to 3μ, with an equivalent noise input of 6×10^{-10} W at 2.7μ. The time constant is less than a microsecond. C.Hilsum

537.312.5 : 535.3

THEORY OF DYNAMIC QUENCHING OF PHOTOCONDUCTIVITY AND LUMINESCENCE. See Abstr. 5212

537.312.6 : 548.7

EFFECT OF QUENCHING ON ELECTRICAL RESISTANCE OF GOLD WIRES. See Abstr. 4904

537.312.62

5352. EVALUATION OF SOME NONLOCAL THEORIES FOR A THIN SUPERCONDUCTING FILM. J.R.Schrieffer.
Phys. Rev., Vol. 106, No. 1, 47-50 (April 1, 1957).

The magnetic susceptibility of a thin superconducting film has been evaluated as a function of film thickness on the basis of nonlocal theories proposed by Pippard, Bardeen and Schafroth and Blatt. Two limiting boundary conditions corresponding to specular reflection and random scattering of the electrons at the surface have been applied, and the susceptibility appears to be insensitive to the boundary condition. Deviations from the London theory occur for a thickness less than twice the penetration depth and give a susceptibility smaller than the London value. Largest deviation is found for the Pippard theory and least for the Schafroth–Blatt version. The experimental data of Lock are inconclusive with regard to the validity of the nonlocal theories. A.

537.312.62

5353. STUDY OF SUPERCONDUCTING Hg BY NUCLEAR MAGNETIC RESONANCE TECHNIQUES. F.Reif.
Phys. Rev., Vol. 106, No. 2, 208-20 (April 15, 1957).

The difficulties associated with the failure of magnetic fields to penetrate inside superconductors can be overcome by the use of dense colloids consisting of particles mostly less than 500 A in diameter. The preparation and characteristics of such Hg colloids are described and some comments are made about the experimental equipment. Experiments show that the superconducting particles give rise to a resonance line with a Knight shift less than that of the line in the normal metal. Considerations affecting the analysis of the data are discussed at some length. Calculations are given for the resonance line shape due to a single spherical superconducting particle and also for that expected from a distribution of such particles of different sizes. A criterion is developed for determining the Knight shift from the observed superconducting line. Corrections for the microscopic broadening of the resonance line and for the bulk diamagnetism of the sample are derived. It is point out that the bulk magnetization curve of the superconducting colloid can also readily be measured by means of the nuclear resonance equipment. In measurements ranging from 750 to 2300 gauss the Knight shift K_S in the superconductor at 1.20°K is found to be 1.6%, or about $\frac{2}{3}$ of its value in the normal metal. Experiments designed to elucidate the temperature dependence of the Knight shift K_S are also discussed. Some general quasi-thermodynamic comments are made to relate the Knight shift to some properties of the electron interaction energy responsible for superconductivity. Remarks based on the two-fluid model lead to some speculative predictions concerning the temperature dependence of K_S which seem to be in at least qualitative agreement with the temperature dependence suggested by experiment. A.

537.313

5354. KIRCHHOFF'S LAWS AND MAXWELL'S CYCLIC CURRENTS — A PEDAGOGICAL POINT. W.W.Robertson.
Amer. J. Phys., Vol. 25, No. 1, 38-9 (Jan., 1957).

The chain of thought leading from Kirchhoff's laws to Maxwell's cyclic currents is demonstrated in terms of the unbalanced Wheatstone bridge circuit. S.Weintroub

ELECTRIC DISCHARGES 537.52

537.521

5355. GROWTH OF CURRENT BETWEEN PARALLEL PLATES. P.M.Davidson.
Phys. Rev., Vol. 106, No. 1, 1-2 (April 1, 1957).

The proof of the author's exact explicit solutions for the case of current growth involving two secondary processes at the cathode is here explained more fully than in his original papers (Abstr. 6812/1953). Some new forms of the solution, useful for special purposes, are given; one of them is the accurate form of an approximate solution recently proposed by Miyoshi. A.

537.523.4

5356. BROADENING OF A SPARK CHANNEL IN AIR AT CURRENTS OF ABOUT 2 x 10^6 AMPERES. V.S.Komel'kov and D.S.Parfenov.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1215-18 (1956). In Russian.

In these experiments a bank of 48 capacitors giving 132 μF was used at a working voltage of 40 or 50 kilovolts. At 40 kV currents of 1.7 x 10^6 A were obtained with the initial slope of the current v. time curve of 10^{12} A/sec. At 50 kV currents of 2 x 10^6 A were obtained. Recording of the development of the spark channel was done photographically using rotating mirror and Kerr cell techniques. During broadening of the discharge channel four characteristic phases are observed: (a) up to 0.7 μsec broadening of channel occurs at $>$ 2 x 10^6 cm/sec falling to 4 x 10^5 cm/sec and the current density rises to 10^7 A/cm^2, previously only observed with electrical explosion of wires, (b) a broken boundary occurs with the discharge channel, (c) shock waves are formed spreading with velocity, (0.8-1.2) 10^6 cm/sec, (d) the rate of broadening of the channel decreases, oscillating about a mean value with period τ = 18 μsec. Some theoretical discussion of events is given. C.R.S.Manders

537.523.5 : 535.33.03

SELF-ABSORPTION OF SPECTRAL LINES IN ARCS. See Abstr. 5159

537.525.3

5357. ROLE OF TRANSVERSE MAGNETIC FIELDS IN THE ELECTRODELESS GAS DISCHARGE AND IN THE JOSHI EFFECT. S.R.Mohanty and T.R.Bhat.
Acta phys. Polon., Vol. 15, No. 5, 353-7 (1956).

Describes the effect of magnetic fields on the Joshi effect in oxygen. This effect is essentially the alteration in high voltage a.c. "electrodeless" corona discharge currents when external irradiation of the discharge tube is used. J.D.Craggs

537.525

5358. THE VELOCITY DISTRIBUTION FUNCTION FOR ELECTRONS IN A VARIABLE ELECTRIC AND CONSTANT MAGNETIC FIELD. A.V.Gurevich.
Dokl. Akad. Nauk SSSR, Vol. 104, No. 2, 201-4 (1955). In Russian.
Engligh translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 752 (1956).

A theoretical paper, which gives a treatment of the h.f. case, when only elastic collisions between electrons and molecules (or atoms) is considered. J.D.Craggs

537.525

5359. PRODUCTION OF A CONTINUOUS CURRENT BY A HIGH-FREQUENCY DISCHARGE. I. M.Chenot.
J. Phys. Radium., Vol. 17, No. 10, 842-8 (Oct., 1956). In French.

Describes the characterstics of a discharge in hydrogen excited at low pressures with external electrodes at a frequency of 7.69 Mc/s. The collector characteristics of internal electrodes in the gas, between which a current passes, are obtained as a function of pressure and excitation voltage. The effects and nature of the thin deposits formed on the internal electrodes are discussed. J.W.Sturgess

537.525

5360. STUDIES OF RECTIFICATION IN A GAS (NITROGEN) DISCHARGE BETWEEN COAXIAL CYLINDRICAL ELECTRODES. III. RECTIFICATION IN FULL OZONIZERS. V.L.Talekar.
J. Electronics, Vol. 2, No. 4, 341-57 (Jan., 1957).

For Pt II, see Abstr. 2271 (1957). Potential variation of rectification is studied in full ozonizers over a wide range of pressure ranging from 6 to 350 mm of Hg using a supply frequency of 50 c/s. The behaviour of a full ozonizer, in general, is in variance with that of a semiozonizer (or Maze counter). Only in the range of small values of $p\delta$ does it seem to be somewhat similar. Deductions made from the theory of rectification as regards the magnitude and sign of rectification in full ozonizer discharge are in fair agreement with the experimental results. It is found that the activated layers formed on glass walls backed by the external electrodes not only play an important role in the mechanism of starting positive as well as negative discharges, but they also completely overshadow the effect of electrode asymmetry in determining the sign and extent of rectification in full ozonizers. The theory is successfully applied to explain Chiplonkar's results on rectification in Geissler tubes. A.

537.525

5361. THE PLASMA CHARACTERISTICS OF A LOW-PRESSURE MERCURY DISCHARGE WITH SEVERAL ELECTRON GROUPS. W.H.Schneider.
S.B. Österr. Akad. Wiss. IIa, Vol. 164, No. 5-7, 311-22 (1955). In German.

A detailed account of an investigation of a mercury vapour discharge with anode voltage between 30 and 150 V and anode currents between 25 to 350 mA in the temperature range -20° to $+34^{\circ}$C. Very small plane-probes were used to examine the plasma characteristics in different parts of the discharge. C.G.Morgan

537.525 : 538.63

5362. THE EFFECT OF A UNIFORM MAGNETIC FIELD ON ELECTRODELESS DISCHARGE IN A TUBE AND MEASUREMENT OF ELECTRONIC MOBILITY. S.Deb and S.N.Goswami.
Sci. and Culture, Vol. 22, No. 5, 283-5 (Nov., 1956).

Measurements of the breakdown potential of an electrodeless straight discharge tube, with and without a transverse magnetic field, are described. Dry air was used at pressures of 1-10 mm of Hg, with potentials of 0.56-4.10 kV r.m.s., and a magnetic field of 1000 gauss. A theory of the observed increases of breakdown potential on application of magnetic field leads to calculated values of electron mobility agreeing in order of magnitude with those obtained by other methods. B.Meltzer

537.525.3

5363. ROLE OF CONTINUED EXCITATION IN THE POTENTIAL INVERSION OF THE JOSHI EFFECT. S.R.Mohanty, L.V.Kannan and S.Visvanathan.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1590-1 (Dec., 1956).

A further discussion of certain matters relating to the striking voltage etc. of external-electrode high-voltage a.c. corona discharges. J.D.Craggs

537.525.5

5364. ON CAUSES OF REGULAR MOTION OF THE CATHODE SPOT OF AN ELECTRIC ARC IN A MAGNETIC FIELD. I.G.Kesaev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 619-22 (1957). In Russian.

In the presence of a uniform magnetic field the cathode spot of a low-pressure discharge moves in a direction opposite to that expected. Recent work in interpreting these results recognises the importance of the magnetic field of the cathode end of the arc. Near the boundary of the spot the field intensity may reach 600 oersteds. Combination of this field and the applied lateral field produces marked asymmetry of field distribution at the edges of the spot and it is this which is the main cause of the particular motion of the cathode spot at low pressure. What should happen in the case of a Hg discharge at low pressure with transverse magnetic field is worked out in some detail and a photograph of such a case is given and seen to agree with the calculation. C.R.S.Manders

537.525.83

5365. SIMILARITY RELATIONS AND THE CATHODE DARK SPACE. W.A.Gambling.
Phys. Rev., Vol. 106, No. 2, 203-5 (April 15, 1957).

In a study of the cathode dark space of the glow discharge von Engel, Seeliger, and Steenbeck found deviations from the similarity laws at high pressures. By using a correct solution to their (slightly modified) energy-balance equation and more recent values of the constants, agreement is obtained between the calculated and measured values of current density over the pressure range 1 to 760 mm Hg. This, together with other experimental evidence, shows that the similarity laws are valid over this pressure range, thus enabling various properties of the dark space to be determined and indicating that the fundamental mechanisms are the same as at low pressures. A.

537.528

5366. BUBBLE CHAMBER STUDY OF ELECTRIC BREAKDOWN OF LIQUID. S.Nagao.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1205 (Nov., 1956).

Bubbles in superheated diethyl ether show the location of discharges when 1 msec rectangular voltage pulses are applied between point–sphere electrodes. J.H.Mason

X-RAYS 537.531

537.531 : 538.222 : 538.221

5367. X-RAY EMISSION SPECTRA OF Mn AND Cu IN A HEUSLER ALLOY IN THE MAGNETIC TRANSITION RANGE OF TEMPERATURES. É.E.Vaĭnshteĭn and B.I.Kotlyar.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 44-7 (1956). In Russian.

The form and position of lines of the $K\beta$-group of Mn and Cu were studied in a Heusler alloy near the composition Cu_2AlMn, as well as the corresponding characteristics of the $K\alpha_{1,2}$ lines of the same elements over a wide range of temperatures. Details of the X-ray tube for these studies are given. With change from ferromagnetic to paramagnetic state there is a marked change in the form of the $K\beta_5$ lines, for Mn the lines shift towards the long-wave end of the spectrum whilst for Cu the opposite happens. Intensity measurements on these $K\beta_5$ lines are in qualitative agreement with Sokolov and Tsipis (Abstr. 9689, 9756/1955). The present authors consider that the changes in certain characteristics of Cu spectrum lines in this Heusler alloy during transition through the Curie point indicate that Cu, besides providing the basic lattice for carrying Mn atoms, also takes a large part in the ferromagnetism of the alloy. C.R.S.Manders

537.531 : 539.153.4

5368. A RE-MEASUREMENT OF THE $L\alpha_{1,2}$ LINES OF LANTHANUM. P.C.Russell and E.A.Stewardson.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 91-3 (Jan., 1957).

Wavelengths obtained, with a focusing crystal spectrometer, were 2660.06 X.U. and 2669.71 X.U. The effect on the M-shell energy levels is discussed. A.R.Stokes

537.531 : 535.43

5369. MODIFIED RADIATION IN X-RAY SCATTERING. K.Das Gupta.
Sci. and Culture, Vol. 21, No. 9, 542-3 (March, 1956).

A note indicating the improved methods adopted to examine the beams of scattered monochromatic X-rays for evidence of change of wavelength due to transitions between quantum states where the electron is retained by the atom. See also K.Das Gupta, Abstr. 149 4907 (1951). J.Iba

537.531 : 612.843.

ON THE VISIBILITY OF X-RAYS. See Abstr. 4928

537.531.0

5370. STANDARD IONIZATION-CHAMBER REQUIREMENTS FO 250- TO 500-KILOVOLT X-RAYS. H.O.Wyckoff and F.S.Kirn.
J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 111-17 (Feb., 1957).

Information is provided on the correction factor required for th determination of the dose in roentgens of 250- to 500-kilovolt X-ra from measurement with a free-air ionization chamber. Special emphasis is placed on the determination of each of the factors so th an over-all accuracy of 0.5% can be obtained. A

CATHODE RAYS. POSITIVE RAYS 537.533/.534

537.53

5371. ELECTRON PHYSICS TABLES. L.Marton, C.Marton and W.G.Hall.
Circ. Nat. Bur. Stand., No. 571, 83 pp. (1956).

The tables are intended as replacement of "Miscellaneous Physics Tables. Pt II. Electronic Functions" (Mathematical Tables 17 of the National Bureau of Standards, 1941). Eight parameters are tabulated with an eight-digit accuracy: (1) V = potential difference in volts; (2) $V^* = V + e/2m_0c^2V^2$, where e = electronic charge in e.m.u., m_0 = electron rest-mass in g, c = velocity of light in cm sec^{-1}; (3) $H\rho = (2m_0V^*/e)^{1/2}$; (4) $\lambda = h(2m_0eV^*)^{-1/2}$, where h = Planck's constant in erg sec; (5) $p^* = (2eV^*/m_0c^2)^{1/2}$; (6) $E^* = 10^8e/m_0c^2$; (7) $W^* = E^* + 1$; (8) $\beta = p^*/W^*$.

537.533 : 621.384.6

5372. THE FRASCATI 1000 MeV ELECTRON SYNCHROTRON AND ITS POTENTIALITIES FOR RESEARCH. G.Salvini.
Energia nucleare, Vol. 3, No. 6, 435-9 (Dec. 15, 1956). In Italian.

Electron synchrotrons, at present in use or under constructio of energies > 500 MeV are compared in a table giving their dimen sions, powers, and other data. The Frascati electron synchrotron described in detail. The floor plan and the cross-section of the magnet are illustrated. Dimensions of the latter are given. Vario possibilities for experiment are examined, such as the photoprodu tion of heavy mesons and hyperons at their threshold energies, an of pions, electron-pairs, and the study of the Compton effect at hig energies. This machine promises to be useful tool in the study of electron dynamics. J.J.Phip

537.533.2

5373. WORK-FUNCTION STUDIES OF GERMANIUM CRYSTALS CLEANED BY ION BOMBARDMENT. J.A.Dillon, Jr and H.E.Farnsworth.
J. appl. Phys., Vol. 28, No. 2, 174-84 (Feb., 1957).

The work functions of germanium single crystals have been obtained by measuring the contact potential differences between the germanium crystals and a gold reference whose work function was measured by the Fowler method. Work function values for the bombardment-cleaned surfaces of three samples having comparable resistivities were the same within experimental error (4.78 ± 0.015 eV). Variation in the doping concentration resulted in work-function changes smaller than those predicted by a simple Fermi level shift. Adsorption of oxygen at pressures of about 1×10^{-7} mm Hg resulted in work-function increases of about 0.20 eV. The clean surface work-function values could be restored after O_2 adsorption by heating at 500°C for 15 min. For those cases in which changes were noted, adsorption of hydrogen and nitrogen at higher pressures (10^{-3} mm Hg) resulted in decreases of work function, while CO adsorption increased the work function. Measurements of the effects of strong electric fields and intense illumination on the work function suggested that these effects were associated with rather thick surface layers which could be removed by vacuum heating or ion-bombardment cleaning. The photoelectric-threshold level was near or slightly above the Fermi level for the ion-bombardment cleaned surfaces. After oxygen adsorption the threshold level was below the Fermi level. A.

537.533.2

5374. ELECTRON EMISSION OF SOLIDS AFTER MECHANICAL WORKING OR AFTER IRRADIATION (EXO-ELECTRONS AND PHOTOELECTRONS). E.L.Huguenin and J.G.Valat.
J. Phys. Radium, Vol. 17, No. 11, 965-75 (Nov., 1956). In French.

A review of the techniques for observation of, and the results and theories of, exo-electron emission from solid surfaces. The theoretical analogy with luminescence and phosphorescence mechanisms is stressed. G.F.J.Garlick

537.533.2

5375. THE ELECTRON EMISSION DURING OXIDATION OF MECHANICALLY WORKED METAL SURFACES. J.Lohff.
Z. Phys., Vol. 146, No. 4, 436-46 (1956). In German.

Freshly worked zinc gives no emission in vacuum or nitrogen but does so in the presence of oxygen. The phenomena are thus more likely to be chemical in origin than due to mechanical rearrangement. However, the emission falls with increasing temperature which has to be interpreted by the hypothesis that the electron energy is given up to the lattice vibrations at sufficiently high temperatures. A.H.W.Beck

537.533.3

5376. ON THE "ELECTRON MICROSCOPICAL TRANSPARENCY" OF THIN FILMS. W.Lippert.
Optik, Vol. 13, No. 11, 506-15 (Nov., 1956). In German.

The electron optical transparencies of various thin films, measured with the help of an electron microscope, are compared with theoretical calculations of Lenz (Abstr. 7490/1954) and found to be in general agreement. A full description of the experimental technique is given. A.E.I. Research Laboratory

537.533.3

5377. INTERFERENCE AND DIFFRACTION FRINGES IN ELECTRON OPTICS: FRESNEL DIFFRACTION, YOUNG'S PINHOLES, FRESNEL BIPRISM. J.Faget and C.Fert.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2028-9 (Dec. 17, 1956). In French.

Describes the equipment necessary to illustrate the electron-optical equivalents of the optical effects mentioned. J.Thewlis

537.533.3

5378. REMARKS ON THE SUBJECT OF THE PRECEDING NOTE. L.de Broglie.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2029 (Dec. 17, 1956). In French.

See preceding abstract. Points out that the experiments provide an elegant proof of the principles of wave mechanics. Particular attention is paid to the fact that a long train of coherent waves is associated with an electron. J.Thewlis

537.533.3

5379. ON THE DIFFRACTION THEORY TREATMENT OF ELECTRON OPTICAL IMAGING ABERRATIONS. J.Picht.
Optik, Vol. 13, No. 11, 494-501 (Nov., 1956). In German.

Referring back to concepts developed in his optical diffraction theory (1925), the author shows how these may be adapted to electron optical aberrations. The chief difference lies in that electron optics involves media of continuously changing refractive index; it therefore proves convenient in various applications to imagine media of fictitious refractive index, and to replace conventional wave surfaces by surfaces of constant phase. A.E.I. Research Laboratory

537.533.3

5380. THIRD-ORDER PATHS IN ELECTRON MIRRORS. P.Schiske.
Optik, Vol. 14, No. 1, 34-45 (Jan., 1957). In German.

For computing third-order trajectories in electron lenses, the trajectories are generally assumed to be inclined at small angles to the axis. This assumption is not valid for electron mirrors in the neighbourhood of the reversal point. A fully described perturbation procedure, based on the eiconal method, and using axial distance as the independent variable, is here shown to be capable of overcoming this difficulty. A.E.I. Research Laboratory

537.533.3 : 537.534.3 : 778.34

EMULSION-STACK STUDY OF CHARGED PARTICLE MOMENTA. See Abstr. 4955

537.533.33

5381. APERTURE ABERRATIONS OF STRONGLY CONVERGING ELECTRON LENSES. M.Y.Bernard and J.Hue.
C.R. Acad. Sci. (Paris), Vol. 244, No. 6, 732-5 (Feb. 4, 1957). In French.

It is shown that the cross-section of an electron beam emerging from a strong electrostatic or magnetic lens may take one of several complicated forms. These are calculated, to the third order, by a perturbation method, and the resulting expressions are applied to a particular practical case. A.E.I. Research Laboratory

537.533.33

5382. TREATMENT OF TRANSITION POINTS IN THE "PARABOLA METHOD" AND SIMILAR COMPUTATION PROCEDURES. P.Schiske.
Optik, Vol. 13, No. 12, 529-36 (Dec., 1956). In German.

When, for the purpose of computation, the potential distribution in an electron lens is approximated by a number of analytic functions each valid over a limited region, errors are introduced into the computed electron trajectories by the discontinuities which arise where two regions meet. These were not dealt with adequately in earlier treatments, e.g. Regenstreif's "parabola method". Expressions are here given which enable corrections to be made.
A.E.I. Research Laboratory

537.533.331

5383. CALCULATION OF INDUCTION AND ITS DERIVATIVES ON THE AXIS OF A ROTATIONALLY SYMMETRICAL MAGNETIC LENS. M.Laudet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1855-7 (Dec. 5, 1956). In French.

It is shown that if the axial distribution of the induction in a magnetic electron lens of a particular simple form is known, then, by virtue of the principle of superposition, the distribution for any other form can be simply deduced. A.E.I.Research Laboratory

537.533.332

5384. THE LOWER LIMIT OF THE CHROMATIC-ABERRATION OF MAGNETIC LENSES HAVING A PRESCRIBED MAXIMUM FIELD STRENGTH. P.Schiske.
Optik, Vol. 13, No. 11, 502-5 (Nov., 1956). In German.

The minimum chromatic aberration of magnetic electron lenses with given maximum field strength is calculated, and compared with earlier estimates. The field form required for this could be approached, but never quite reached in practice.
A.E.I. Research Laboratory

537.533.335

5385. STUDY OF THE EFFECTIVE FOCAL LENGTH OF A 4-POLE MAGNETIC LENS AND THE VARIATIONS IN THE GAP. A.Septier.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1297-300 (Oct. 29, 1956). In French.

From measurements of the field and field gradient in certain quadrupolar magnetic electron lenses the "effective lengths" along various lines parallel to the axis are determined. It is shown that these correspond to negative spherical aberration.
A.E.I. Research Laboratory

537.533.335

5386. ON THE LOWER LIMIT OF SPHERICAL ABERRATION IN MAGNETIC ELECTRON LENSES. W.Tretner.
Optik, Vol. 13, No. 11, 516-19 (Nov., 1956). In German.

Following criticism of his earlier work by Grümm (Abstr. 3770/

1956), the author expands this and discusses in detail the various factors affecting the minimization of spherical aberration in magnetic lenses. A.E.I. Research Laboratory

537.533.35

5387. ON THE THEORY OF THE REFLECTION ELECTRON MICROSCOPE. D.Wiskott.
Optik, Vol. 13, No. 11, 481-93 (Nov., 1956). In German.

Continuation of previous work (Abstr. 2296/1957). The reflection of electrons by an object of periodic structure is treated wave-mechanically. A typical theoretical resolving power is of the order of 80 A.U., but practical considerations make it unlikely that resolution better than 120 A.U. could be attained.

A.E.I. Research Laboratory

537.533.35 : 537.311.3

5388. STEREO-MICROGRAPHS OF CONDUCTIVITY. L.Mayer.
J. appl. Phys., Vol. 28, No. 2, 259-63 (Feb., 1957).

Deals with the utilization of electron mirror microscopy for pictorial representation of the distribution of electrical conductivity. Previously described conductivity pictures obtained by this novel kind of electron microscopy have been of the normal two-dimensional type; this paper reports three-dimensional display of conductivity distributions. It discusses the concept of "stereo-micrographs of conductivity". It is shown that a three-dimensional display of the conductivity distribution of thin films is possible by combining two electron mirror micrographs to a stereo-pair. The two micrographs are distinguished solely by the amount of current passing through the specimen. As experimental evidence of the feasibility of three-dimensional "conductivity pictures" a stereo-micrograph of a test sample with artificially prepared areas of different conductivities is shown. Limitations and precautions to be observed are briefly discussed. A.

537.533.35

5389. CONSTRUCTION OF A MAGNETIC ELECTRON-VELOCITY SPECTROGRAPH. C.Fert and F.Pradal.
C.R. Acad. Sci. (Paris), Vol. 244, No. 2, 54-6 (Jan. 2, 1957). In French.

In order to study the distribution of velocities in a beam of electrons after interaction with matter, a velocity spectrograph has been devised. A magnetic prism with plane parallel sides is used as a dispersive element. The spectrum is recorded on a photographic plate, a quadrupole lens being used to focus the selected bundle of electrons on to the plate. A resolution of one part of 20 000 is claimed. A.E.I. Research Laboratory

537.533.35 : 621.314.7 : 621.316.721

5390. A BETA RAY SPECTROGRAPH USING A TRANSISTOR CURRENT REGULATOR. M.Kipfer-Bogaert.
Rev. H.F., Vol. 3, No. 7, 268-70 (1956). In French.

The regulator previously described (Rev. H.F., Vol. 3, No. 7, 255-67, 1956) controls the electromagnet current of a uniform-magnetic-field type spectrograph as described by Rutherford. Line spectra only were examined. The principle of operation and causes of errors are briefly indicated. The construction is shown and also the spectrum obtained from RaB. The flux density of 4×10^{-2} Wb/m^2 (400 gauss) was produced by about 2 A in 1000 turns, with a 4 cm air-gap. The field was very stable and variable over a wide range.

J.S.Young

537.533.74

5391. ON THE SCATTERING OF HIGH ENERGY ELECTRONS BY PROTONS. E.Clementel and C.Villi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1207-11 (Nov., 1956).

Using the proton charge density calculated by F.Zachariasen in the one-meson approximation (Abstr. 4831/1956), the effect of the electron penetration into the meson cloud has been calculated. In view of a 35% discrepancy with experiments at 550 MeV, a different approach, based on a modified photon propagation function, is suggested. It is found that the existing data can be well reproduced, and critical tests at higher energies, and some implications, are pointed out. W.A.Hepner

537.533.74

5392. ELECTRON SCATTERING BY THE DEUTERON. R.G.Newton.
Phys. Rev., Vol. 105, No. 2, 763-4 (Jan. 15, 1957).

It is shown that the effective range and scattering amplitude do not determine the form factor of the deuteron wave-function. A potential is constructed for which the form factor varies between its extreme limits without change in the former quantities.

G.E.Brown

537.533.75

5393. SPATIAL DISTRIBUTION OF ENERGY ABSORBED FROM AN ELECTRON BEAM PENETRATING ALUMINUM. F.N.Huffman, J.S.Cheka, B.G.Saunders, R.H.Ritchie and R.D.Birkhoff.
Phys. Rev., Vol. 106, No. 3, 435-40 (May 1, 1957).

An electron beam introduced into an infinite medium is scattered and absorbed as the electrons slow down. The ionization produced by the beam in a plane air-cavity perpendicular to the initial beam direction was used to measure the spatial rate of energy dissipation at various distances from the plane of incidence. At beam energies of 57, 80, 104, and 126.5 keV, agreement within a few percent on an absolute basis with the Spencer theory of electron penetration was found if the value of W, the average energy to make an ion pair, is taken for air to be 34 eV per ion pair. A.

537.533.75

5394. THE ABSORPTION OF BETA PARTICLES AS A FUNCTION OF ATOMIC NUMBER. S.A.Husain and J.L.Putman.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 304-5 (April, 1957).

The absorption of electrons from P^{32} is studied in a number of elements. The efficiency of absorption is shown to increase systematically with atomic number. It is suggested that the effect is due to nuclear scattering. An approximate formula is given for the relation between equivalent thickness of absorber and atomic number. Experiments with Sr^{90} and Y^{90} give a similar dependance on Z.

L.L.Green

537.533.8

5395. EFFECT OF MECHANICAL CONSTRAINTS ON THE SECONDARY ELECTRON EMISSION OF POLYCRYSTALLINE METALLIC SUBSTANCES. F.Davoine and R.Bernard.
J. Phys. Radium, Vol. 17, No. 10, 859-65 (Oct., 1956). In French.

Plastic deformation of metallic tapes and wires (Mo, Al, Au, Ni) produces up to 20% increase in secondary emission. Annealing causes a reversion to the unstrained value. The results show a dependence of secondary emission on crystal defects.

G.F.J.Garlick

537.533.

5396. BREMSSTRAHLUNG SPECTRA CORRECTED FOR MULTIPLE SCATTERING IN THE TARGET. E.Hisdal.
Phys. Rev., Vol. 105, No. 6, 1821-6 (March 15, 1957).

The spectral distribution in the forward direction of bremsstrahlung from a platinum target is evaluated for some typical cases taking into account the multiple scattering of the incident electrons in the target. It is found that the proportion of high-energy photons is larger than in Schiff's intrinsic integrated spectrum. Tables are given of the correction factors to be applied to Schiff's spectrum for some typical target thicknesses and electron energies from 10-300 MeV. For incident electrons of energies 10-70 MeV it is found that the intrinsic differential spectrum for $\theta = 0$ gives a better approximation to the spectrum corrected for multiple scattering than the integrated spectrum does.

537.533.8 : 621.317

5397. REVERSE CURRENT IN AN INSTRUMENT OF THE SPHERICAL CONDENSER TYPE. M.Ya.Mandel'shtam.
Zh. tekh. Fiz., Vol. 26, No. 10, 2234-42 (1956). In Russian.

Energy distribution of secondary electrons can be studied using a spherical condenser instrument due to P.Lukirsky (Z.Phys., Vol. 22, 351, 1924). A reverse current may arise in this instrument due to primary electrons reflected from the target causing secondary emission from the collector. Dependence of reverse current on the p.d. between the target and collector is derived for a given relation between their radii and fixed energy of electrons emitted from the collector. The result obtained is applied to different energy distribution functions of the reverse electrons. It is shown, that the use of the curve of reverse current recommended in the literature for determination of contact potential difference, can lead to a substantial error. The effect of reverse current on results of investigations of energy distribution of secondary electrons is considered.

Z.Krasucki

537.533

5398. CHERENKOV RADIATION AND ITS PRACTICAL APPLICATIONS. J.E.Terry.
Atomic Energy Res. Establ. (Harwell) Inf. Bibl. 90 (Suppl. 1), 18 p. (1957).

A continuation of the bibliography referred to in Abstr. 5697 (1954).

537.533.9

5399. DISTRIBUTION OF ENERGY IN THE SPECTRUM OF NON-COHERENT RADIATION OF ELECTRONS MOVING IN A SYNCHROTRON. Yu.M.Ado and P.A.Cherenkov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 35-7 (1956). In Russian.

The energy spectrum has been measured in the spectral interval 4000-6100 A by means of a prism monochromator viewed by a photomultiplier. The electrons moved in a 100 cm radius orbit of a 250 MeV synchrotron. The intensity was monitored by an ionization chamber measuring the bremstrahlung. Measurements were done at 150, 225 and 250 MeV. The result is in agreement with theoretical calculations by D.Ivanenko and A.Sokolov (see Abstr. 1889/1949), P.A.Artsimovich and I.J.Pomeranchuk (Zh. éksper. teor. Fiz., Vol. 16, 379, 1946), and J.Schwinger (Abstr. 5460/1949). H.Motz

537.533.9

5400. EXPERIMENTAL INVESTIGATION OF ANGULAR DISTRIBUTION AND POLARIZATION OF OPTICAL RADIATION OF ELECTRONS IN A SYNCHROTRON. F.A.Korolev, V.S.Markov, E.M.Akimov and O.F.Kulikov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 542-4 (1956). In Russian.

Earlier work by Elder, Gurewitsch, Langmuir and Pollock (Abstr. 2578/1947), Elder, Langmuir and Pollock (Abstr. 2859/1948) failed to detect radiation with a polarization with the electric vector parallel to the magnetic field while in the present work both the component parallel and the component perpendicular to the magnetic field of the synchrotron were found. The parallel component is several times weaker. For both components the angular distribution has been measured. Interference filters with a pass band of 100 A were used to define the wavelength of the light. The angular distribution is in agreement with theoretical predictions by D.Ivanenko and I.J.Pomeranchuk (Dokl. Akad. Nauk SSSR, Vol. 44, 315, 1944), P.A.Artsimovich and I.Pomeranchuk (Zh. éksper. teor. Fiz., Vol. 16, 379, 1946) and R.I.Schiff (Rev. sci. Instrum., Vol. 17, 6, 1946). H.Motz

537.533.9 : 539.166.835

5401. THEORY OF HIGH-ENERGY BREMSSTRAHLUNG AND PAIR PRODUCTION IN A SCREENED FIELD. H.Olsen, L.C.Maximon and H.Wergeland.
Phys. Rev., Vol. 106, No. 1, 27-46 (April 1, 1957).

The differential cross-sections for high-energy bremsstrahlung and pair production in a screened Coulomb field are calculated without the use of the Born approximation. It is shown that for pair production the correction to the Born approximation occurs only for momentum transfers q of order mc, for any amount of screening. For bremsstrahlung, however, the correction is only important for q's of order $(mc^2/E)mc$, where E is the energy of the electron. As in the case of no screening, the correction to the differential cross-section for bremsstrahlung is found to be given by a factor multiplying the Bethe–Heitler cross-section. It is then shown that the bremsstrahlung cross-section integrated over the angles of the final electron is additive, just as in the case of pair production: one part is the Bethe–Heitler cross-section including screening, to this is then added the Coulomb correction which is independent of screening. The cross-sections are evaluated by using wave-functions which are accurate in the region in space which contributes significantly to the matrix element. This region is determined by the order of magnitude of q, and different wave-functions must be used in the regions (I) corresponding to q's of order mc and (II) corresponding to q's of order $(mc^2/E)mc$. In (I) the wave-functions are obtained by an expansion in partial waves and use of a W.K.B. method on the radial wave-equation. In (II) a W.K.B. technique is used on the three-dimensional wave-equation itself. Corrections due to the use of Sommerfeld–Maue wave-functions, which are solutions to the second order Dirac equation, are shown to be negligible. Finally, the method is used to obtain the cross-section for small-angle elastic scattering. A.

537.533.9 : 539.153.4

ELECTRON EXCITATION OF 3p LEVELS OF O I. See Abstr. 4645

537.534

5402. GYROSCOPIC ANALOGIES FOR CIRCULAR ACCELERATORS. F.Fer.
C.R. Acad. Sci. (Paris), Vol. 244, No. 5, 566-8 (Jan. 28, 1957). In French.

537.534

5403. EXCITATION OF BETATRON OSCILLATIONS BY SYNCHROTRON MOMENTUM OSCILLATIONS IN A STRONG-FOCUSING ACCELERATOR. Yu.F.Orlov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 130-4 (1957). In Russian.

Resonance between synchrotron oscillations of momentum and amplitude beats near resonance in magnetic field perturbations is demonstrated. Resonance sets in if the ratio between the beat frequency and frequency of synchrotron oscillations is an integer. Transition through these resonances is examined in the linear and non-linear approximations. A.

537.534.3

5404. A NEW PULSE METHOD OF MEASURING THE MASSES OF IONS. S.G.Alikhanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 517-18 (1956). In Russian.

The suggested device consists of a drift tube placed in a weak axial magnetic field into which pulses of ions can be directed. At both ends of the tube two retarding potentials are switched on after the injection, so that the axial oscillations of ions with the same mass between the ends should be nearly isochronous. Owing to the different periods of oscillation of ions with different masses, after a certain interval the oscillating bunches of ions will be conveniently separated and can therefore be extracted by suitable gating. Some calculations and design figures for a practical case are given. G.Martelli

537.534.74

5405. RELATIVISTIC CORRECTIONS TO p–p SCATTERING. G.Breit.
Phys. Rev., Vol. 106, No. 2, 314-20 (April 15, 1957).

Effects of wave-function distortion by nuclear forces of non-electromagnetic origin are qualitatively considered. It is found that the relativistic corrections to the Coulomb wave contain effects of wave-function distortion which may affect these corrections by reasonably large fractional amounts. The spin–orbit interactions arising from the action of the electric field are found to be affected by wave-function distortion. Since these interactions affect the polarization of proton beams in double and triple scattering, the analysis of high-energy data is affected. The theory of spin–orbit interactions is brought into relation with that of atomic spectra. The unreliability of contact terms contained in the relativistic corrections is brought out. A concise proof of the vanishing of first order tensor force effects on the polarization applying independently of the origin of the tensor force effects is supplied in an appendix. A.

537.534.74

5406. POLARIZATION OF PROTONS SCATTERED FROM CARBON AT 970 MeV. G.J.Batty and S.J.Goldsack.
Proc. Phys. Soc. A, Vol. 70, Pt 2, 165-6 (Feb., 1957).

Preliminary experiments on the Birmingham proton synchrotron are reported. The method used is described; 5000 tracks have been counted so far. Considerable polarization effects are in evidence at this energy, in good agreement with theory. N.M.King

537.534.75

5407. RANGE OF 6- TO 18-MeV PROTONS IN Be, Al, Cu, Ag, AND Au. H.Bichsel, R.F.Mozley and W.A.Aron.
Phys. Rev., Vol. 105, No. 6, 1788-95 (March 15, 1957).

An experimental study has been made of the range and straggling of protons of 6 to 18 MeV in Be, Al, Cu, Ag, and Au. The following values of I have been obtained: Be: 63.4 eV, Al: 166.4 eV, Cu: 375.6 eV, Ag: 585 eV, and Au: 1037 eV. New range–energy curves are computed using these data and the low-energy data summarized by Allison and Warshaw. The mean straggling is evaluated to approximately 5%. In magnitude it is in agreement with theory but there is a lack of symmetry above and below the 50% point which remains unexplained. A.

537.534.8

5408. ELECTRON EMISSION FROM DIELECTRIC FILMS BOMBARDED WITH POSITIVE HYDROGEN IONS. V.Z.Surkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 14-19 (1957). In Russian.

Electron emission produced by bombardment of dielectric films with positive ions and continuing after cessation of the ion bombardment has been investigated. Hydrogen, oxygen and lithium ions were used to excite electron emission. It is shown that emission is observed in CaF_2, B_2O_3, Al_2O_3 films and in mica sheets. The dependence of the emission on the target temperature was studied. Work functions of the film surfaces were measured. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

5409. PROPORTIONAL COUNTERS FOR DEMONSTRATION EXPERIMENTS. A.Moljk and R.W.P.Drever.
Amer. J. Phys., Vol. 25, No. 3, 165-8 (March, 1957).

Proportional counters suitable for demonstration purposes are described, and some experiments to illustrate counter operation are discussed. The charge carried by the positive ions produced in the multiplication process, and the localization of the avalanche, is revealed in a special proportional counter whose cathode is covered by a layer of polythene. Other properties of this type of counter, wuch as its ability to work for a considerable period of time without a high-voltage supply, are pointed out. A.

537.542

5410. FABRICATION OF α-SCINTILLATORS INSENSITIVE TO THE AMBIENT LIGHT. B.Mougin and Y.Koechlin.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 135A-136A (Nov., 1956). In French.

Full details are given for the construction of screens for the detection of α-particles, in which ZnS.Ag settled on a transparent support is rendered opaque to exterior light by an assembly of four Formvar membranes metallized by evaporated Al. The total thickness of Al is 0.8 mg/cm^2. With a photomultiplier the screens gave 30% efficiency in counting α-particles from uranium.

S.T.Henderson

537.542

5411. TWO SIDED SPARK COUNTER WITH LARGE COUNTING AREA FOR REGISTERING SLOW NEUTRONS. J.A.Janik and A.Szkatuła.
Acta phys. Polon., Vol. 15, No. 5, 343-9 (1956).

This paper describes a two-sided spark counter for detecting thermal neutrons. The counter has cathode area of 7.5×11 cm^2 and is covered on both sides by a coating of boron. The total length of the 0.08 mm dia. wires which form the anode of the counter is about 3 mm. From the characteristics drawn for different concentrations of CO_2 in the air forming the atmosphere of the counter, it can be seen that as the CO_2 concentration increases, the counter efficiency increases, the plateau length decreases and the slope of the characteristic increases. The conditions necessary for the stable operation of the counter are given. A.

537.542

5412. TECHNIQUES IN HIGH-RESOLUTION COINCIDENCE COUNTING. G.H.Minton.
J. Res. Nat. Bur. Stand., Vol. 57, No. 3, 119-29 (Sept., 1956).

Circuitry, systems, and techniques used in radiation coincidence measurements with millimicrosecond resolution are discussed. An analysis of the time fluctuations in a scintillation counting system is presented and comparisons with experimental results are made. A.

537.542 : 539.16.08

5413. EFFICIENCY OF 4π-CRYSTAL-SCINTILLATION COUNTING. I. EXPERIMENTAL TECHNIQUE AND RESULTS. C.C.Smith, H.H.Seliger and J.Steyn.
J. Res. Nat. Bur. Stand., Vol. 57, No. 5, 251-5 (Nov., 1956).

The technique of 4π-crystal-scintillation counting has been applied to the standardization of beta-emitting nuclides. Phototubes viewing an anthracene sandwiched source at 180° have been used with high-gain nonoverloading amplifiers in addition and in coincidence circuits to obtain high detection efficiencies. A precise shorted delay-line coincidence analyser is described. The results of measurements made with P^{32}, Co^{60}, Sr^{90}-Y^{90}, I^{131}, and Tl^{204} are compared with those obtained by $4\pi\beta$-gas-proportional counting. A.

537.542

5414. EFFICIENCY OF 4π-CRYSTAL-SCINTILLATION COUNTING. II. DEAD-TIME AND COINCIDENCE CORRECTIONS. W.B.Mann and H.H.Seliger.
J. Res. Nat. Bur. Stand., Vol. 57, No. 5, 257-64 (Nov., 1956).

The dead-time and coincidence corrections to be applied in 4π-crystal-scintillation counting have been both approximately and rigorously derived. It has been shown that under special conditions the non-randomness due to "true" counts appearing in both channels requires additional correction terms. A.

537.542

5415. THE DESIGN AND OPERATION OF A CLOUD CHAMBER. L.A.Madonna.
Canad. J. Technol., Vol. 34, No. 8, 485-94 (March, 1957).

The design and operation of an expansion type cloud chamber is discussed. The difficulty in most cloud chambers is that the carrier gas is impure and therefore the condensation achieved is heterogeneous. The entire design and operational objective of this chamber was to obtain homogeneous nucleation and growth of water droplets. An equation is also given relating the initial temperature of the saturated pure nitrogen gas to the temperature at which water vapour is condensed homogeneously. A.

IONIZATION. THERMIONICS 537.56/.58

537.561

5416. MODIFICATION OF THE FRANCK–HERTZ EXPERIMENT. R.A.Bernheim, A.C.Gossard and R.V.Pound.
Amer. J. Phys., Vol. 24, No. 9, 630-1 (Dec., 1956).

The critical potential of Hg can be measured rapidly by use of an oscilloscope in place of the galvanometer hitherto used in the above experiment. A variable d.c. voltage, superimposed on a 60 c/s a.c. voltage is applied to one grid of a thyratron, and by varying the d.c. voltage the successive oscillations in anode current may be observed. The voltage differences between successive maxima give the values for the first excitation potential of Hg. The apparatus can also be used for measuring the ionization potential of Hg. A circuit diagram is given. The sole purpose of the apparatus is educational. N.Corcoran

537.561

5417. IONIZATION AND DISSOCIATION OF HEXAFLUOROBENZENE BY ELECTRON IMPACT. V.H.Dibeler, R.M.Reese and F.L.Mohler.
J. chem. Phys., Vol. 26, No. 2, 304-5 (Feb., 1957).

Mass spectra and appearance potentials are presented for the principal positive and negative ions of hexafluorobenzene along with comparative data for benzene. Although complete analysis of bond dissociation energies is prevented by lack of thermochemical data, the C–F bond is estimated to be 145 kcal. Qualitatively, the results indicate that C_6F_6 is thermally more stable than C_6H_6 and is a relatively stable configuration in the presence of ionizing radiation. A

537.561

5418. IONIZATION POTENTIALS OF SOME MOLECULES. K.Watanabe.
J. chem. Phys., Vol. 26, No. 3, 542-7 (March, 1957).

The ionization potentials of eighty-nine molecules have been determined by photoionization measurements. The results are tabulated and compared with those obtained by spectroscopic and electron impact methods. Uncertainties in interpretation and several discrepancies are discussed. A

537.563

5419. ELASTIC AND INELASTIC SCATTERING OF LOW-VELOCITY H^- IONS IN HYDROGEN. II. E.E.Muschlitz,Jr, T.L.Bailey and J.H.Simons.
J. chem. Phys., Vol. 26, No. 3, 711-12 (March, 1957).

By modifying apparatus used previously (Abstr. 5952/1956), better estimates of the inelastic cross-sections were obtained which agree with those of Hasted and Smith (Abstr. 4469/1956). The elastic cross-sections are revised by 10% or more; this increases the observed difference between H^-–H_2 and H^+–H_2 interactions. R.S.Peas

537.56

5420. IONIZATION EFFICIENCY CURVES AND THE STATISTICAL THEORY OF MASS SPECTRA. I.Friedman, F.A.L and M.Wolfsberg.
J. chem. Phys., Vol. 26, No. 3, 714-15 (March, 1957).

Points out that theory implies a dependence of the shape of ionization curves on molecular size, even when monoenergetic electrons are assumed; the usual extrapolation to zero current would then lead, for large molecules, to values of appearance potentials greater than the minimum dissociation energy. On the other hand, experimental values are in reasonable agreement with thermochemical calculations. It is suggested that the discrepancy is due to the theoretical assumption of completely random distribution of excitation energy, among the internal degrees of freedom of the parent i before decomposition; such randomization may not occur in practi N.M.Kin

537.5

5421. STUDY OF PLASMAS IN THE TRANSIENT REGION. J.Salmon.
J. Phys. Radium, Vol. 17, No. 11, 931-3 (Nov., 1956). In French.

The Boltzmann equation for a Lorentzian electron gas is solv in the absence of external forces, for the case of constant collisio frequency. For uniform electron density n the velocity distributio function is found to retain its initial Maxwellian form, with an "instantaneous temperature" which decreases exponentially with time. In the general case n satisfies a diffusion equation in which the diffusion coefficient is a function of the time. E.H.Sondheim

537.562

5422. IONIZATION AND DISSOCIATION OF THE TRIFLUORO-METHYL HALIDES BY ELECTRON IMPACT. V.H.Dibeler, R.M.Reese and F.L.Mohler.
J. Res. Nat. Bur. Stand., Vol. 57, No. 2, 113-18 (Aug., 1956).

Relative abundances and appearance potentials are reported for positive and negative ions observed in CF_4, CF_3Cl, CF_3Br, and CF_3I. The kinetic-energy distribution of positive ions is obtained by means of a "beam-deflection" technique. These data combined with that of recent thermochemical and spectroscopic studies permit a new calculation of the ionization potential of the CF_3 radical of 9.3 ± 0.2 electron volts, as well as estimates of fluorocarbon bond-dissociation energies. The energetics of probable dissociation processes are discussed. A.

537.562

5423. MASS SPECTRUM OF SULFUR VAPOR. P.Bradt, F.L.Mohler and V.H.Dibeler.
J. Res. Nat. Bur. Stand., Vol. 57, No. 4, 223-5 (Oct., 1956).

The mass spectrum of sulphur vapour has been measured by evaporating sulphur from a heated tube directly into the ionization chamber of a mass spectrometer. Ions S_x^+ with x ranging from 1 to 8 are observed with S_2^+ most abundant. Isotope abundances were computed from the S_2^+ ions. The appearance potentials of S_8^+ and S_2^+ are respectively 8.9 ± 0.2 and 8.3 ± 0.2 electron volts. This suggests that the vapour in the ionization chamber is a mixture of molecules containing S_2 and S_8 and possibly other molecules. A.

537.562

5424. DISSOCIATION OF MOLECULAR HYDROGEN IONS (H_2^+) IN GASES. K.K.Damodaran.
Proc. Roy. Soc. A, Vol. 239, 382-93 (March 12, 1957).

Cross-sections have been measured for the dissociation of 200 keV H_2^+ ions in H_2, D_2, He, N_2, O_2, Ne, A, Kr, Xe, CH_4, H_2S, CO_2 and N_2O. Measurements have also been made at 175, 150 and 100 keV for H_2 and He and at 150 keV for N_2 and A. For each gas and each energy, the mean number of protons produced in the dissociation of a molecular ion has been obtained. For H_2, N_2 and A, observations have been made of the angular distribution of the H^0 particles about the direction of the primary 200 keV H_2^+ ions. A.

537.562 : 536.633

EFFECT OF MULTIPLE THERMAL IONIZATION ON THE SPECIFIC HEAT OF GASES. See Abstr. 5288

537.564

5425. THE IONIC IMPACT METHOD AND THE ESTIMATION OF THE PROTON AFFINITY OF MOLECULES.
V.L.Tal'roze and E.L.Frankevich.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 2, 376-9 (1956). In Russian.

From observations on whether reactions such as $R_1H + M^+ \rightarrow R_1 + MH^+$, $R_2H + M^+ \rightarrow R_2 + MH^+$ "go" or not, it is possible to "bracket" the proton affinity of the molecule M fairly closely. In this way, by studies on the formation of H_3O^+ from impacts of ionized water molecules H_2O^+ on ammonia, acetylene, hydrogen sulphide, propane, and the corresponding reactions with un-ionized water molecules and ionized reactants (ammonia, etc) it has been established that the proton affinity of H_2O lies between 7.23 and 7.44 eV or 166 and 173 kg cal/mole. A special mass spectrometer, with which it was possible to record the potentials of appearance and the initial kinetic energy of the ions in question, was used. R.C.Murray

537.564 : 537.534.8

5426. EXPERIMENTAL DETERMINATIONS OF CHARGE TRANSFER CROSS SECTIONS AND SECONDARY ELECTRON EMISSION BY ION BOMBARDMENT. S.N.Ghosh and W.F.Sheridan.
J. chem. Phys., Vol. 26, No. 3, 480-5 (March, 1957).

The method utilized for determining charge transfer cross-sections (Abstr. 6566/1955) has been improved and applied to symmetric and unsymmetric reactions involving the inert gases, N_2, H_2 CH_4, C_2H_4, C_2H_6, and C_3H_8. The cross-sections were found to be about 20% higher than the values previously reported. The discrepancy can be explained by the fact that in previous experiments cross-sections were determined from net charge measurements without taking full account of the secondary electrons impinging on the plate where the charge transfer ions were collected. As expected from adiabatic hypothesis, the reactions involving mixtures of gas having nearly equal ionization potentials were found to have maximum cross-sections for low-energy ions. The interaction distances were calculated from the observed ion energy for which the cross-sections are a maximum. The method described can be utilized to determine the secondary electron emission from a metal surface due to ion bombardment. Such determination has been made for a brass surface. Relating the variation of emission with the ion mass and energy, it is found that the emission varies inversely as the square root of the ion mass. A.

537.564

5427. SENSITIZED PHOTOIONIZATION IN FAR ULTRAVIOLET. I. Tanaka and E.W.R. Steacie.
J. chem. Phys., Vol. 26, No. 3, 715-16 (March, 1957).

When an atomic species A has a resonance potential exceeding the ionization potential of a species B, the photoionization of B can take place in a mixture through the process $A^* + B \rightarrow A + B^+ + e$. Results are presented for Kr in NO. R.S.Pease

537.564

5428. INELASTIC COLLISIONS BETWEEN HEAVY PARTICLES. VII. ELECTRON LOSS FROM FAST HYDROGEN ATOMS PASSING THROUGH HELIUM. D.R.Bates and A.Williams.
Proc. Phys. Soc. A, Vol. 70, Pt 4, 306-9 (April, 1957).

For Pt VI see Abstr. 4495 (1957). The cross-section for ionization of hydrogen atoms by collision with helium atoms is calculated using Born approximation and the results are compared with the measurements of Stier and Barnett. Above 100 keV the agreement is found to be satisfactory but below the agreement is poor. Reasons for the disagreement below 100 keV are discussed. L.L.Green

537.564

5429. ANOMALIES IN THE ADIABATIC INTERPRETATION OF CHARGE-TRANSFER COLLISIONS. H.B.Gilbody and J.B.Hasted.
Proc. Roy. Soc. A, Vol. 238, 334-43 (Jan. 8, 1957).

This paper describes the measurement of seventeen charge-transfer cross-sections in the energy ranges 10 to 300 eV, 3 to 40 keV. The dependence of the cross-sections on energy can in most cases be explained on "near-adiabatic" theory, but A^+ in Kr, Ne^+ in A and C^+ in Kr show anomalous cross-sections of 1 to 2 πa_0^2, varying slowly with energy, in the near-adiabatic region; these are possibly due to the pseudo-crossing of the potential energy curves. A.

537.565

5430. AN ALTERNATING FIELD METHOD FOR MEASURING THE MOBILITIES OF GASEOUS IONS. E.Montel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1735-7 (Nov. 26, 1956). In French.

An alternating field of known frequency is applied between two grids mounted between positive and negative plate electrodes of an ionization chamber. When an ion source is situated at the negative electrode the current across the chamber is a minimum when the frequency of the alternating voltage is the reciprocal of the ion transit time between the grids. J.H.Mason

537.565

5431. IONIC DRIFT VELOCITIES AND ELECTRON ATTACHMENT COEFFICIENTS IN OXYGEN. D.S.Burch and R.Geballe.
Phys. Rev., Vol. 106, No. 2, 183-7 (April 15, 1957).

Transient ion currents following an initiating electron pulse have been studied in oxygen over a range of pd from 7 to 26 cm mm Hg and of E/p from 9 to 50 volts/cm mm. Analysis of oscillographic records yields information regarding ionic drift-velocities and the electron attachment coefficient. Three distinct and pressure-independent velocities are found consistent with zero field mobilities of 3.4, 2.6, and 1.95 cm^2/V sec. The multiplicity of velocities is ascribed to clustering reactions through which a single initially formed species of negative ion is converted into two slower species, although initially formed O_2^+ ions retain their identity. It is then possible to compute the attachment coefficient from measured ion transient areas. The attachment coefficient thus obtained varies gently in the region $10 \leq E/p \leq 25$ and joins at each end with curves previously reported. Consideration of the mobilities of the ions as well as other evidence leads to the identification of the initial ion as O^-, while the clustered species appear to be O_3^- and O_2^- corresponding, respectively, to the above mobilities. No difference is detected between the mobilities of O_2^+ and O_2^- ions. A.

537.565

5432. TEMPERATURE DEPENDENCE OF ION MOBILITIES IN HELIUM, NEON, AND ARGON. L.M.Chanin and M.A.Biondi.
Phys. Rev., Vol. 106, No. 3, 473-9 (May 1, 1957).

Measurements have been made of the temperature variation of the atomic and molecular ion mobilities in the parent gases, helium, neon, and argon over the range 77-300°K. The experimental values for the atomic ion mobilities are compared with calculations based on Holstein's theory. The results for neon and argon are in good agreement with the values calculated from the theory. This is in contrast to the case of helium where the experimental results lie

consistently below the theoretical values. The molecular ion mobilities are compared with the temperature variation predicted by the Langevin and Hassé–Cook theories. The experimental results in neon and argon lie intermediate between the predictions of the two theories in agreement with expectations; however, the helium data cannot be reconciled with either of these theories. A.

537.566

5433. ON THE POSITIVE AND NEGATIVE IONS IN DIFFUSION FLAMES. T.Kinbara and H.Ikegami.
Sci. Pap. Coll. Gen. Educ. Univ. Tokyo, Vol. 6, No. 2, 129-45 (Dec., 1956).

Using a probe method, measurements were made of the potential distribution in an electric field applied between a specially designed burner and a wire held in the flame associated with it. A theoretical relationship is obtained which enables approximate values for the mobilities in various parts of the flame to be deduced from these measurements. It is concluded that the ions are created mainly in the lower part of the flame as positive ions and electrons, and that as the electrons ascend they become negative ions whereas the positive ions remain unchanged. J.Dutton

537.568

5434. RECOMBINATION AND AFTERGLOW IN NITROGEN AND OXYGEN. R.B.Bryan, R.B.Holt and O.Oldenberg.
Phys. Rev., Vol. 106, No. 1, 83-6 (April 1, 1957).

Measurements were made on pure N_2, using standard microwave cavity techniques, of the coefficient of electron recombination, α. Pressures ranged from 3 to 30 mm Hg. Spectrograms were obtained of the afterglow. Higher vibrational levels of the second positive bands are enhanced relative to those obtained from electronic excitation. Goldstein–Kaplan bands, the green bands of Gaydon, and the Herman bands in the range 7000-9000 A were also relatively much stronger. The (0.0) first negative band was observed 1500 microseconds after the end of the discharge. Light intensity measurements by means of a photomultiplier tube showed a peculiar behaviour of the relative intensities of the first positive and second positive bands. The number of photons emitted was large as compared to the number of electron-ion pairs recombining. In the afterglow of oxygen the only light observed was the (0,0) atmospheric band and weak radiation in the region 3500 A to 4500 A, which is thought to be a continuum. The continuum decreases in intensity as though it were the result of a two-body process. A.

537.568

5435. CLUSTERING OF NEGATIVE IONS IN OXYGEN.
D.S.Burch and R.Geballe.
Phys. Rev., Vol. 106, No. 2, 188-90 (April 15, 1957).

Observed transient ion currents in oxygen below breakdown at low pd deviate from those predicted by use of the assumption that ions are formed during the initiating electron pulse and retain their identity while drifting in the electric field. The deviations, ascribed to clustering reactions that generate O_2^- and O_3^- from initially formed O^-, are analysed to obtain values for the clustering rates. These rates have orders of magnitude comparable with ionization and attachment rates under the experimental conditions. Their variation with E/p and p are discussed and possible clustering reactions are suggested. A.

537.572

5436. GENERALIZED EQUATIONS FOR THE IONIZATION OF SOLID PARTICLES. H.Einbinder.
J. chem. Phys., Vol. 26, No. 4, 948-53(April, 1957).

A generalized formula is derived for the ionization of spherical solid particles of submicroscopic size by allowing for multiple ionization. A system of simultaneous equilibrium equations is set up connecting successive states of ionization. Its solution yields a generalized formula that reduces to the Saha equation when only single ionization can occur. When the particles are multiply ionized, the equation can be simplified by the method of steepest descents,

$$N_e/N = (rkT/e^2)\ln(K/N_e) + \tfrac{1}{2}, \quad (N_e/N > \sim 3),$$

where N_e is the electron concentration, N is the number density of solid particles, r their radius and $K = 2(2\pi mkT/h^2)^{3/2}\exp(-\varphi/kT)$. This equation is applied to the observations of Shuler and Weber on the ionization of free carbon particles produced in rich acetylene–oxygen flames. Their data is consistent with a work function $\varphi = 4.35$ eV, identical with that of graphite, and particle radii between 55 and 85 A. A.

537.58

5437. SAHA'S THEORY OF THERMAL IONISATION.
N.R.Sen.
Sci. and Culture, Vol. 22, No. 5, 264-8 (Nov., 1956).

A simple account of the theory and its consequences. P.M.Davidson

537.581

5438. THERMIONIC CONSTANTS AND SORPTION PROPERTIES OF HAFNIUM. H.D.Hagstrum.
J. appl. Phys., Vol. 28, No. 3, 323-8 (March, 1957).

Thermionic emission measurements on polycrystalline hafnium in the temperature range 1250 to 1820°K have yielded a work function of 3.60 eV and a thermionic constant A of 22.9 A cm^{-2} deg^{-2}. Intermittent heating thereafter for a total of 46 hr at temperatures above 2100°K and at pressures below 1×10^{-9} mm Hg did not change these parameters appreciably. No gas was desorbed from the hafnium when it was flashed to 2150°K after having been cold for 64 hr. A second sample of hafnium was used as a target in apparatus for studying electron ejection by ions. It was more brittle than the first and thus more contaminated with gas. Its work function was found to be 3.91 eV and the constant A to be 20.5 A cm^{-2} deg^{-2} after repeated flashing to 2150°K. Evidence from the electron ejection work indicates that the surface of this second hafnium sample was covered with an appreciable fraction of a monolayer immediately after cooling from high temperature. One can conclude that the work function of hafnium increases as the metal irreversibly absorbs gas on heating. A.

537.583

5439. STUDIES ON THE MECHANISM OF OPERATION OF THE L CATHODE. I. E.S.Rittner, R.H.Ahlert and W.C.Rutledge.
J. appl. Phys., Vol. 28, No. 2, 156-66 (Feb., 1957).

Performance characteristics of the L cathode, including emission, evaporation rate, and evaporant composition, are presented, followed by an investigation of the constitution of the emitting surface. Activation of the external tungsten surface is effected by the migration thereover of strongly adsorbed BaO issuing from the pores. The active surface, which is continuously renewed during life, comprises a nearly complete oxygen monolayer on tungsten covered in turn by a complete barium monolayer. The oxygen in the dipole layer enhances emission and drastically increases the sticking time of barium. The cathode emission is close to the maximum that can be expected from a barium activated tungsten dispenser cathode. A.

537.583

5440. STUDIES ON THE MECHANISM OF OPERATION OF THE L CATHODE. II. W.C.Rutledge and E.S.Rittner.
J. appl. Phys., Vol. 28, No. 2, 167-73 (Feb., 1957).

An experimental study of the L cathode is presented, including the chemistry of carbonate decomposition and barium generation, the origin of BaO in the evaporant, the barium transport mechanism through the porous plug, and the factors determining cathode life. Carbonate decomposition is accompanied in low porosity cathodes by the deleterious reaction

$$BaCO_3 + \tfrac{1}{3}W = \tfrac{1}{3}Ba_3WO_6 + CO.$$

Barium is generated in the cavity at an equilibrium pressure by the reaction

$$2BaO + \tfrac{1}{3}W = \tfrac{1}{3}Ba_3WO_6 + Ba$$

and is transported continuously through the porous tungsten predominantly by Knudsen flow. During transport the barium acquires oxygen from the tungsten, producing in the evaporant a large BaO content which helps to activate the surface. Termination of life coincides with completion of the BaO–W reaction and onset of the subsequent reaction

$$\tfrac{2}{3}Ba_3WO_6 + \tfrac{1}{3}W = BaWO_4 + Ba,$$

which is accompanied by release of a poisoning agent. Material decrease in evaporation rate and a corresponding increase in cathode life may be gained by addition of $SrCO_3$. A.

537.583 : 535.377 : 537.311.3

ELECTRONIC CONDUCTIVITY, THERMOLUMINESCENCE AND THERMIONIC EMISSION IN IONIC CRYSTALS. See Abstr. 5313

COSMIC RAYS 537.591

537.591.1

5441. ON THE ORIGIN OF COSMIC RAYS. V.L.Ginzburg.
Dokl. Akad. Nauk SSSR, Vol. 99, No. 5, 703-6 (1954). In Russian.

The modified theory of interstellar acceleration (Fermi, Abstr. 5212/1954; Morrison et al., Abstr. 6708/1954) meets with very serious difficulties. In particular it is difficult to obtain a reasonable value for the exponent γ in the energy distribution $f(E)\,dE = E^{-\gamma}dE$, which would be in agreement with the experimental value of $\gamma \sim 2$-3. S.Chomet

537.591.1 : 539.18

5442. MASS MEASUREMENTS OF SLOW COSMIC-RAY MESONS. M.Inoki, T.Yasaki, M.Machida and Y.Matsukawa.
Phys. Rev., Vol. 105, No. 6, 1872-4 (March 15, 1957).

The masses of slow charged cosmic-ray particles (except those of protonic mass) in the soft and hard components were separately determined by measuring momentum, momentum loss, and ionization with a magnetic cloud chamber at sea-level. With respect to meson masses, however, no appreciable difference between the two components could be found. 80 out of 87 observed particles were interpreted as μ-mesons, leaving 7 anomalous ones. A.

537.591.15 : 539.172.11

5443. NUCLEON–PION CASCADES IN THE ATMOSPHERE PRODUCED BY α-PARTICLES. S.Ganguly.
J. Technol. (Calcutta), Vol. 1, No. 2, 113-21 (Dec., 1956).

The nucleon–pion cascades initiated by α-particles have been investigated by assuming the transparency of the nucleus and the average number of central collisions as found experimentally. The numerical results have been carried over to the results of a previous work for the generation of showers by cosmic-ray protons. The total integral intensities have been calculated and the neutron–proton ratios have been shown graphically. The extent and size of the cascade and the attenuation mean free paths bear good agreement with observed data. A.

537.591.5

5444. THE DIURNAL VARIATION OF THE BAROMETER COEFFICIENT FOR COSMIC RAYS AT HOBART. R.M.Jacklyn.
Austral. J. Phys., Vol. 9, No. 4, 505-10 (Dec., 1956).

The records from a vertical counter telescope measuring the hard component of cosmic radiation at sea-level have disclosed significant diurnal variations of the barometer coefficient at Hobart, Tas. The amplitude of the variation is about 5 per cent, and there are secular changes of the same order during the mean day. It is shown that it is meaningless to correct the diurnal variations of intensity to conditions of standard surface pressure using a barometer coefficient averaged over the mean day if the standard pressure chosen is very different from the observed mean value. Moreover, there is evidence from the Hobart results for 1954 that the observed diurnal maximum of the corrected intensities is associated with a low barometer coefficient and the minimum with a high coefficient, suggesting that the form of the corrected intensity variations may be determined largely by variations occurring within the atmosphere. Possible reasons for the variation of the barometer coefficient are discussed and an experiment is suggested which might decide what is the main cause of these variations, a changing primary spectrum or changing properties of the atmosphere. A.

537.591.5

5445. 27-DAY RECURRENCE TENDENCY IN THE DAILY VARIATION OF COSMIC RAY MESON INTENSITY. R.P.Kane.
Proc. Nat. Inst. Sci. India A, Vol. 22, No. 6, 398-407 (1956).

The Carnegie Institution data for Huancayo for the period 1937 to 1945 have been analysed for the study of a 27-day recurrence tendency in the daily variation of cosmic-ray meson intensity. Quantities D–N and E–M which represent the 6-hour and 12-hour components of the daily variation at Huancayo after allowing for the deflection of cosmic-ray particles in the earth's magnetic field are studied separately. Each of the two factors reveals a 27-day recurrence tendency which is not equally prominent in all years and is apparently unconnected with the sunspot cycle. The maxima of D–N and E–M do not seem to be related to each other. A relationship with C_p indices, representative of geomagnetic activity, is also investigated. A.

537.591.8 : 539.18

5446. A TRANSITION EFFECT OF π-MESONS PRODUCED BY THE NEUTRAL COMPONENT OF COSMIC RAYS IN LEAD. V.Sh.Kamalyan.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 6, 1169-71 (1954). In Russian.

The number of π-mesons produced in lead by the neutral component of cosmic rays was measured as a function of thickness, using the Alikhanov–Alikhanian mass spectrometer in conjunction with a special counter arrangement, at an altitude of 3250 m. Three thicknesses were used: 3, 10, 15 and 35 cm. The number of π-mesons produced in the 15 cm block of lead appears to be higher than for the other three blocks. S.Chomet

MAGNETISM 538

538.114

5447. THE CALCULATION OF PRIMARY EXCITATIONS IN MAGNETIC SUBSTANCES. P.G. de Gennes.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1730-2 (Nov. 26, 1956). In French.

A general discussion of the spin-wave treatment and its application to neutron diffraction and the Bloch wall. E.P.Wohlfarth

538.114

5448. DEPENDENCE OF THE FERROMAGNETIC RESONANCE LINE WIDTH ON THE SHAPE OF THE SPECIMEN. A.D.Berk.
J. appl. Phys., Vol. 28, No. 2, 190-2 (Feb., 1957).

The dependence of line width of the ferromagnetic resonance on the shape of the sample is examined on phenomenological grounds. If a damping term of the Bloch–Bloembergen type is assumed in the equation of motion of the magnetization, the line width for an ellipsoidal sample is given by $\Delta H = [1 + M_s^2\gamma^2(N_x-N_y)^2/4\omega^2]^{-1/2}2/\gamma T_2$. The Landau–Lifshitz form of damping leads to a line width which is independent of the shape of the specimen. A.

538.114

5449. DISPERSION RELATIONS FOR TENSOR MEDIA AND THEIR APPLICATION TO FERRITES. B.S.Gourary.
J. appl. Phys., Vol. 28, No. 3, 283-8 (March, 1957).

The well-known Kronig–Kramers integral relations between the real and imaginary parts of the susceptibility are generalized to the case where the susceptibility is a tensor. The consequences of the principle of energy conservation are discussed. The case of a ferrite is discussed in some detail. A

538.114

5450. EXCHANGE AND SUPEREXCHANGE COUPLING BETWEEN CONDUCTION ELECTRONS AND D ELECTRONS IN MAGNETIC MATERIALS. G.W.Pratt, Jr.
Phys. Rev., Vol. 106, No. 1, 53-66 (April 1, 1957).

An analysis is made of the magnetization of the conduction electrons in a ferromagnetic material induced by their exchange interaction with the d-electrons. The problem is set up by using the density matrix some special properties of which are proved in the appendix. When this formalism is used, the exchange interaction between a conduction electron and the inner as well as the d-electrons associated with a given atom are found as a function of the relative spin orientation of the atom and the conduction electron. The problem is treated for $T \ll T_C$ and for $T \sim T_C$. Results for Fe have been calculated by using the nearly free electron method and the cellular methods. The effect of correlation is taken into account by the Bohm and Pines technique. A magnetization of about 0.20 μ_0 per atom is found. An antiferromagnetic coupling is found to be possible between magnetic ions in dilute alloys such as has been found experimentally in Cu–Mn. The mechanism is a superexchange coupling of the magnetic ions through the conduction electrons. A molecular field theory has been worked out for this case on the basis of an antiferromagnetic coupling between the magnetic ions and a ferromagnetic coupling between these ions and the conduction electrons. This theory is found to admit the possibility of an antiferromagnetic–ferromagnetic transition. Application of this theory to the Cu–Mn alloys shows that it is unnecessary to assume that the s-d exchange interaction is as weak as previously believed. It is, furthermore, suggested that the combination of direct and superexchange interactions between the 4f and conduction electrons in the rare earths is responsible for their magnetic properties and in particular is the source of the observed antiferromagnetic–ferromagnetic transitions in erbium and dysprosium. A.

538.221

5451. MAGNETIC PROPERTIES OF THE RARE EARTH FERRITES $5Fe_2O_3.3M_2O_3$ with M = Tb, Dy, Ho, Er, Tm, Yb, Lu. R.Pauthenet.

C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1499-502 (Nov. 12, 1956). In French.

Reports results of measurements between 2° and 700°K and in fields up to 2×10^4 oersted of the temperature variation of the saturation magnetization and the susceptibility above the Curie point. E.P.Wohlfarth

538.221

5452. INTERPRETATION OF THE MAGNETIC PROPERTIES OF THE FERRITES $5Fe_2O_3.3M_2O_3$ with M = Y, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu. R.Pauthenet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1737-40 (Nov. 26, 1956). In French.

See preceding abstract. The experimental results are interpreted on the basis of Néel's theory (Abstr. 9381/1954). Below about 100°K the orbital moment of the M ions is partially quenched. The magnitude and nature of the interactions is discussed. E.P.Wohlfarth

538.221

5453. MAGNETIC AFTER-EFFECT DUE TO FLUCTUATIONS IN THE NEIGHBOURHOOD OF THE CURIE POINT.
D.Pescetti and J.C.Barbier.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1740-3 (Nov. 26, 1956). In French.

Reports results of measurements of the quantity S_V up to about 320°K for an alloy 70% Ni, 27% Cu, 3% Be; S_V increases with temperature, reaches a maximum at about 260°K and then decreases to vanish at the Curie point. Results are also given for the coercive force and the reversible and irreversible susceptibilities. E.P.Wohlfarth

538.221 : 539.185.9

5454. EFFECT OF PILE IRRADIATION ON THE MAGNETIC PROPERTIES OF ZINC FERRITE. H.Forestier, G.Eischen and G.Guiot-Guillain.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1842-5 (Dec. 5, 1956). In French.

Neutron irradiation followed by thermal treatment alters the magnetization of zinc ferrite (paramagnetic before irradiation) through the introduction of defects in the spinel lattice. E.P.Wohlfarth

538.221

5455. STUDY OF THE TERNARY ALLOYS PALLADIUM–NICKEL–COPPER. J.Cohen.
C.R. Acad. Sci. (Paris), Vol. 243, No. 23, 1845-7 (Dec. 5, 1956). In French.

Reports results of susceptibility measurements between 0° and 800° C on alloys with 6.9% Ni and up to 18.7% Cu, and deduces the values of the Curie constant and the paramagnetic Curie temperature; both decrease linearly with Cu concentration. E.P.Wohlfarth

538.221

5456. STUDY OF HYDROGENATED PALLADIUM–NICKEL AND PALLADIUM–COBALT ALLOYS. J.Cohen and J.Wucher.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 49-52 (Jan. 2, 1957). In French.

Reports results of susceptibility measurements at room temperature on Pd–Ni (10% Ni) and Pd–Co (2.5% Co) containing varying amounts of hydrogen. The susceptibility decreases linearly with H content and vanishes when H/(Pd + Ni, Co) ≅ 0.6, but the Curie temperature is independent of the H content. E.P.Wohlfarth

538.221

5457. OBSERVATION OF MAGNETIC VISCOSITY OF FERRITES AT LOW TEMPERATURES. R.V.Telesnin and I.A.Lednev.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 48 (1957). In Russian.

Using the conventional layout for a specimen in the form of a washer, hysteresis loops were observed on an oscilloscope at room and liquid nitrogen temperatures respectively, conditions otherwise being strictly comparable. At 293°K the loop was tall and narrow and of small area. At 78°K the loop was short and wide and of large area. Clearly the lowering of induction on account of viscosity is considerable and it is pointed out that this should be considered when designing apparatus containing ferrites that may have to work at very low temperatures. C.R.S.Manders

538.221

5458. MAGNETIC ANISOTROPY OF THE IRON SULFIDE SINGLE CRYSTAL AT [THE] α-TRANSFORMATION TEMPERATURE.
T.Kamigaichi, T.Hihara, H.Tazaki and E.Hirahara.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1123 (Oct., 1956).

The temperature variation of the magnetic susceptibility of a single crystal of $FeS_{1.04}$ is found to depend strongly on the angle between the c-axis and the applied field direction. The change of the susceptibility at the transformation temperature (about 110° C) is largest when this angle is 0° and very small when it is 90° (field applied in the basal plane). The properties are similar to those of α-Fe_2O_3. E.P.Wohlfarth

538.221

5459. THE EFFECT OF ADDED TITANIUM AND ALUMINIUM ON THE MAGNETIC BEHAVIOUR OF α FERRIC OXIDE. G.Haigh.
Phil. Mag. (Eighth Ser.), Vol. 2, 505-20 (April, 1957).

An examination is made of the magnetic behaviour of hematite, α Fe_2O_3, in the region of the antiferromagnetic transition temperature (−15° C) when titanium and aluminium are added in small amounts as an impurity. Contrary to an earlier observations by Morin (Abstr. 8120/1950) the transition is still observed in the synthesized material for relatively large impurity contents (~ 10%). The magnetic properties and behaviour of some naturally occurring hematites are compared with the synthesized materials, and are shown to be very structure sensitive. Thus the fact that this antiferromagnetic transition is not observed in natural hematite-bearing sandstones is thus probably not due to the presence of impurities but to some effect of crystal structure. A.

538.221

5460. THE MAGNETIC PROPERTIES OF ALLOYS HAVING THE COMPOSITIONS $Mn_{60}\ Al_X\ Zn_{20-x}\ C_{20}$ AND $Mn_{60}\ Ga_X\ Zn_{20-x}\ C_{20}$.
L.Howe and H.P.Myers.
Phil. Mag. (Eighth Ser.), Vol. 2, 554-60 (April, 1957).

In the alloys $Mn_{60}Al_{20}C_{20}$ and $Mn_{60}Zn_{20}C_{20}$ the Bohr magneton number per manganese atom for the ferromagnetic state differs by 0.32, being greater in the zinc alloy. It was thought that this difference could be accounted for by the difference in valencies between Al and Zn, the extra valency electron of the aluminium atom over that of zinc causing a reduction of one Bohr magneton per unit cell, corresponding to 0.33 Bohr magneton per manganese atom. If this were the case then a simple variation of Bohr magneton number might be expected in the alloy system $Mn_{60}Al_XZn_{20-x}C_{20}$. In addition, since the alloy $Mn_{60}Zn_{20}C_{20}$ possesses a transformation at −42° C (when it becomes an antiferromagnetic substance with a complex magnetic structure) whereas the aluminium alloy shows no such transition, measurements on the quaternary alloys should illustrate how this transition is dependent on the electron concentration of the corner atom in the unit cell. The results show a complex behaviour which points against any simple valency mechanism controlling the ferromagnetic properties. Although the lattice parameter of the quaternary alloys varies linearly with Zn–Al content, both the ferromagnetic and antiferromagnetic moments are reduced when aluminium partially replaces zinc in $Mn_{60}Zn_{20}C_{20}$. The ferromagnetic–antiferromagnetic transition moves to lower temperatures and attains 0°K for the composition $Mn_{60}Al_{5.5}Zn_{14.5}C_{20}$. For aluminium contents greater than 5.5% the alloys show only ferromagnetic properties and the saturation moment then increases with increasing Al content. However, at 10% Al the alloys contain two phases and further magnetic measurements are unrewarding. Similar measurements over a more restricted range of composition were made on alloys of the form $Mn_{60}Ga_XZn_{20-x}C_{20}$ and gave results in agreement with those for the Al–Zn alloys. A.

538.221 : 548.74

5461. STACKING DISORDERS IN NICKEL BASE MAGNETIC ALLOYS. R.D.Heidenreich and E.A.Nesbitt.
Phys. Rev., Vol. 105, No. 5, 1678 (March 1, 1957).

Electron diffraction patterns produced by a Perminvar sample show streaks and satellite spots associated with the normal Bragg spots. There are attributed to stacking faults on the 111 planes, and it is suggested that stacking faults in single-phase magnetic alloys may be important in the mechanism which causes these alloys to respond to heat treatment in a magnetic field.. A.E.De Barr

538.221 : 548.74

5462. NEUTRON DIFFRACTION STUDY OF THE MAGNETIC STRUCTURES FOR THE PEROVSKITE-TYPE MIXED OXIDES $La(Mn,Cr)O_3$. U.H.Bents.
Phys. Rev., Vol. 106, No. 2, 225-30 (April 15, 1957).

A neutron diffraction study has been made of the magnetic properties of the series of perovskite-like compounds $La[(1-x)Mn, xCr]O_3$. This series exhibits ferromagnetic and antiferromagnetic properties which depend on the composition of the sample. The antiferromagnetic structure of pure $LaMnO_3$ persists only for very small concentrations of Cr^{+3}; the antiferromagnetic structure characteristic of pure $LaCrO_3$ is found over a large composition range. For samples of intermediate composition a ferromagnetic moment is observed,

the maximum occurring at about 20% Cr^{+3}. In contrast to the mixed oxides $[(1-x)La, xCa]\text{-}MnO_3$ which for certain compositions were truly ferromagnetic, the maximum ferromagnetic moment in this series is very much less than that expected if all the spins were contributing to the moments. A complex ferrimagnetic structure is suggested for the intermediate composition range. A.

538.221 : 541.67

5463. STRUCTURAL AND MAGNETIC PROPERTIES OF SOLID SOLUTIONS OF LITHIUM FERRITE WITH CADMIUM FERRITE AND WITH LITHIUM ALUMINATE. A.E.Carter, P.A.Miles and A.J.E.Welch.
Proc. Instn Elect. Engrs, Paper 2262R, publ. 1957 (Part B Suppl. No. 5, 141-4, 174-8).

Measurements of magnetization (at temperatures down to 90°K) have been made by means of a Sucksmith magnetometer on lithium ferrite ($LiFe_5O_8$) and the following solid solutions: $LiFe_5O_8$—$CdFe_2O_4$ (25, 35, 50, and 75 mol % $CdFe_2O_4$), and $LiFe_5O_8$—$LiAl_5O_8$(10, 20, 30, and 40 mol % $LiAl_5O_8$). The cation distributions in these materials have also been determined as far as possible by X-ray examination. Magnetic and structural measurements both indicate (a) that cadmium ions enter tetrahedral ion-sites in the first solid-solution series, and (b) that aluminium ions in the second series replace ferric ions in both tetrahedral and octahedral sites, with an increasing preference for octahedral sites as the aluminium content increases. The temperature dependence of magnetization for the materials (revealing cases of Neel's R-, P-, and probably N-type behaviour) and the effects of changes in g-value for the iron atoms are discussed. A.

538.221 : 621.318.2

5464. HEAT CHANGES ACCOMPANYING MAGNETIZATION PROCESSES IN FERRITES. L.F.Bates and D.A.Christoffel.
Proc. Instn Elect. Engrs, Paper 2212R, publ. Oct., 1956 (Part B Suppl. No. 5, 231-7, 245-8).

Republication, with discussion, of the paper abstracted in Abstr. 532 (1957).

538.221 : 548.7 : 621.318.12

5465. MAGNETOCRYSTALLINE ANISOTROPY IN COBALT-SUBSTITUTED MAGNETITE SINGLE CRYSTALS. L.R.Bickford, Jr, J.M.Brownlow and R.F.Penoyer.
Proc. Instn Elect. Engrs, Paper 2188S, publ. Oct., 1956 (Part B Suppl. No. 5, 238-44, 245-8).

Republication, with discussion, of the paper abstracted in Abstr. 8275 (1956).

538.221 : 621.318.12

5466. A NEW CLASS OF OXIDIC FERROMAGNETIC MATERIALS WITH HEXAGONAL CRYSTAL STRUCTURES. G.H.Jonker, H.P.J.Wijn and P.B.Braun.
Proc. Instn Elect. Engrs, Paper 2320R, publ. 1957 (Part B Suppl. No. 5, 249-54, 265-6).

Several new groups of ferromagnetic oxides have been found. They have rather complicated chemical compositions and can be obtained as reaction products of Fe_2O_3, BaO and MeO in various proportions, where Me denotes, in general, an element of the first transition group, or either Mg or Zn. The crystal structures of these new compounds can be described in the hexagonal system and are related to the magnetoplumbite structure. The crystal anisotropy of many of these hexagonal compounds is such that, depending on the chemical composition, the spontaneous magnetization in each crystal is oriented either parallel or perpendicular to the hexagonal axis. In the latter case the magnetization can fairly easily be rotated in the basal plane. Polycrystalline sintered samples of such compounds show an initial permeability of about 10; the permeability remains substantially constant up to about 1000 Mc/s, so that these new materials extend the frequency range where ferromagnetic oxides can be advantageously used as core materials to frequencies much higher than is now possible with ferrites having cubic crystal structures. A.

538.221

5467. DOMAIN PATTERNS ON COBALT CRYSTALS. E.O.Hall.
Proc. Phys. Soc. B., Vol. 70, Pt 2, 254-6 (Feb., 1957).

An examination of the powder patterns formed on planes other than the basal prism faces of cobalt, shows that the type of pattern formed on the basal plane is not characteristic of that plane only but appears in a modified form on other planes, finally broadening out to become the known prism face pattern. A theoretical explanation of the results is given in terms of the energies per unit volume of the different domain structures. A.E.De Barr

538.221

5468. HIGH TEMPERATURE SUSCEPTIBILITIES.
A.Danielian and K.W.H.Stevens.
Proc. Phys. Soc. B, Vol. 70, Pt 3, 326-8 (March, 1957).

Following recently reported measurements on MnS a study has been made of the high-temperature properties of antiferromagnetics in which the magnetic ions are on a face centred cubic lattice with nearest neighbour interactions only. It is concluded that to obtain the correct asymptotic Curie temperature by extrapolation of the $(1/\chi,T)$ curve it is necessary to use data obtained at temperatures at least ten times the Néel temperature, and the failure to do this may account for both the high value of the asymptotic Curie temperature obtained in MnS and for some error in the magneton number. G.F.Hodsman

538.221 : 548.736.3

PROPERTIES OF FERROMAGNETIC NICKEL OXIDE. See Abstr. 4905

538.221 : 538.222 : 537.531

CURIE TRANSITION OF A HEUSLER ALLOY. See Abstr. 5367

538.222 : 621.317.79.029.64

5469. SENSITIVITY CONSIDERATIONS IN MICROWAVE PARAMAGNETIC RESONANCE ABSORPTION TECHNIQUES.
G.Feher.
Bell Syst. tech. J., Vol. 36, No. 2, 449-84 (March, 1957).

This paper discusses some factors which limit the sensitivity of microwave paramagnetic resonance equipments. Several specific systems are analysed and the results verified by measuring the signal-to-noise ratio with known amounts of a free radical. The most promising system, especially at low powers, is the superheterodyne detector or barretter homodyne detector. A detailed description of a superhet. spectrometer is given. A.

538.222 : 539.215.2.08

MAGNETIC GRANULOMETRY AND SUPER-PARAMAGNETISM. See Abstr. 4794

538.222 : 539.152.2 : 541.64

PARAMAGNETIC RESONANCE STUDY OF POLYMERS. See Abstr. 4848

538.24

5470. MAGNETIC INDUCTION AND COERCIVE FORCE DATA ON MEMBERS OF THE SERIES $BaAl_xFe_{12-x}O_{19}$ AND RELATED OXIDES.
L.G.Van Uitert.
J. appl. Phys., Vol. 28, No. 3, 317-19 (March, 1957).

Oxides having the magnetoplumbite structure and a wide range of magnetic properties have been examined. The magnetic saturations of the compositions $M^{II}Fe_{12}O_{19}$ can be lowered by replacing part of the iron with the ions Al^{3+}, Ga^{3+}, Mn^{3+}, Cr^{3+}, and Ge^{3+} amongst others. M^{II} in the above formula can be Ba^{2+}, Sr^{2+}, or Pb^{2+}. Calcium can replace these ions in part. Even the samples with magnetic saturations below 200 gauss can be prepared as crystallographically oriented compacts. Contrary to its behaviour in ferrites, Ga^{3+} does not appear to occupy tetrahedral sites in the magnetoplumbite structure. Evidence is presented for the occurrence of points of magnetic compensation in the $BaAl_xFe_{12-x}O_{19}$ series. As the aluminium contents of the materials increase toward such a point, the ratio 2K/I (where K is the magnetocrystalline anisotropy constant and I is the saturation magnetization) also increases. As a consequence the ferromagnetic resonance frequencies associated with the materials move to higher frequencies, and extremely high coercive forces are realized. A.

538.24

5471. COORDINATION QUENCHING OF THE SATURATION MAGNETIZATION OF POTASSIUM FERRICYANIDE. W.E.Henry.
Phys. Rev., Vol. 106, No. 3, 465-7 (May 1, 1957).

An experimental investigation of the result of competition of interatomic interaction forces with the Russell—Saunders coupling has been carried out by magnetization measurements on potassium ferricyanide up to near saturation. Since the asymptotic value of the saturation moment is found to be one Bohr magneton per atom of iron, the application of the Pauli principle seems to give support to the Van Vleck theory of removal of orbital degeneracy of the ^6S state of Fe^{+++}. The results are obtained through a sample motion technique, the sample being kept at temperatures between 1.3 and 4.2°K, and studied in magnetic fields up to 60 000 gauss. A.

538.24 : 621.318.12.013.1

5472. SATURATION MAGNETIZATION OF SOME FERRIMAGNETIC OXIDES WITH HEXAGONAL CRYSTAL STRUCTURES. E.W.Gorter.
Proc. Instn Elect. Engrs, Paper 2355R, publ. 1957 (Part B Suppl. No. 5, 255-60, 265-6).

Anderson's treatment of super-exchange (see Abstr. 8114/1950 and 481/1951) yields a qualitative rule for the dependence of interaction on angle Me-O-Me. Using this rule and assuming a longer distance to lead to a weaker interaction, low-temperature saturation magnetizations for ferrimagnetic oxides with known crystal structures can often be predicted. The results obtained for some of the materials described in that paper, i.e. $Ba_2Me^{II}_2Fe_{12}O_{22}$(Y), $Ba_3Me^{II}_2Fe_{24}O_{41}$(Z), and $BaMe^{II}_2Fe_{16}O_{27}$(W) (in which Me^{II} may be Mn, Fe, Co, Ni, Mg, or Zn), together with those for $BaFe_{12}O_{19}$M and $KFe_{11}O_{17}$, with related crystal structures, are compared with the results of saturation-magnetization measurements down to 20°K. It is shown that very small differences in crystal structure, such as exist between KFeO and M, and between M and Y, can result in drastic differences in spin orientations of neighbouring ions. In particular for Y, the experimental data yield some insight into the distribution of the divalent Me ions among the various lattice sites. The crystal structure of Z is composed of alternating blocks of M and Y, that of W is composed of alternating blocks of M and S(spinel). The saturation magnetizations are obtained by adding those of the composing blocks. A.

538.245 : 548.7 : 621.318.12

5473. FERROMAGNETIC GRANULAR STRUCTURES. P.M.Prache.
Câbles et Transm., Vol. 11, No. 2, 128-66 (April, 1957). In French.

The conclusion of the paper abstracted in Abstr. 4550 (1957).

538.245 : 548.7

5474. DETERMINATION OF THE SPONTANEOUS LATTICE DEFORMATION DURING FERROMAGNETIC TRANSFORMATION. K.P.Belov and I.K.Panina.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 5, 985-7 (1956). In Russian.

A specimen is cooled below the Curie point when it magnetizes spontaneously and strains are set up in it. The spontaneous deformation is found from measurements of the temperature dependence of the magnetostriction of the specimen. Alloys studied consisted of: 32% Ni, 68% Fe; 31% Ni, 5% Co, 64% Fe (invar); 33% Ni, 3% Co, 64% Fe; 36% Ni, 64% Fe; 97.6% Ni, 2.49% Si. The magnetostriction and the square of the spontaneous magnetization are found to vary linearly with T. C.R.S.Manders

ELECTRODYNAMICS 538.3/.5
ELECTROMAGNETISM.

538.3

5475. A SPINOR FORM OF THE ELECTROMAGNETIC EQUATIONS. G.Bodiou.
C.R. Acad. Sci. (Paris), Vol. 243, No. 18, 1287-9 (Oct. 29, 1956). In French.

See Abstr. 8578 (1956).

538.3 : 532.5

5476. SOLUTION OF EQUATIONS OF MAGNETO-AERODYNAMICS FOR UNIDIMENSIONAL MOTION. S.A.Kaplan and K.P.Stanyukovich.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 4, 769-71 (1954). In Russian.

The plasma equations for an ionized gas in a cosmical magnetic field are set up and solutions proposed for the boundary conditions in certain astrophysical and geophysical applications. J.W.Gardner

538.3

5477. THE EQUATIONS OF NON-CONSERVATIVE ELECTROMAGNETISM DERIVED FROM AN INTEGRAL OF INVARIANT ACTION. E.Durand.
J. Phys. Radium, Vol. 17, No. 12, 1016 (Dec., 1956). In French.

The author has given a generalization (Abstr. 6025/1956) of Maxwell's equations for the case when there is creation or annihilation of electric charges. It is necessary to introduce an invariant $\Omega = \partial_q A^q$ (A = four-potential). It is shown here that the generalized equations may be obtained by a variational procedure from a Lagrangian which differs from the usual one by a term Ω^2. L.Pincherle

538.3 : 532.5

5478. STABILITY OF PLASMA IN A STRONG MAGNETIC FIELD. Yu.A.Tserkovnikov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 67-74 (1957). In Russian.

The stability of an inhomogeneous plasma with respect to small perturbations in a strong magnetic field is investigated. The plasma density and temperature and also the magnetic field strength are considered as given functions of space coordinates and as parameters on which the plasma stability is dependent. A.

538.3 : 530.145

PARTICLE ASPECT OF THE ELECTROMAGNETIC FIELD EQUATIONS. See Abstr. 5061

538.313

5479. INTERACTION BETWEEN A MOVING CURRENT FILAMENT AND A CONDUCTING WALL. A.I.Morozov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1079-80 (1956). In Russian.

A filament carrying an alternating current $J(\propto \cos \omega t)$ in the x-direction moves with velocity v ($\ll$ c) in the z-direction parallel to an infinite conducting plane wall. From Maxwell's equations the components of the reaction F between the filament and the wall may be written: $F_x = 0$; $F_y = -(J/c)^2 \mathrm{Re}(P)$; $F_z = -(J/c)^2 \mathrm{Im}(P)$, where

$$P = 2\int_0^\infty \frac{1-\alpha}{1+\alpha}\, e^{-2kl}\, dk,$$

$k = \omega/v$, l = the (constant) distance between the filament and wall, and α = a simple function of k and the electric and magnetic constants of the wall material. Most of the paper is devoted to an evaluation of P in terms of Hankel functions. J.W.Gardner

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

5480. HYDROMAGNETIC OSCILLATIONS OF A FLUID SPHERE WITH INTERNAL MOTIONS. S.Chandrasekhar.
Astrophys. J., Vol. 124, No. 3, 571-9 (Nov., 1956).

A stationary solution of the equations of hydromagnetics for an incompressible inviscid fluid of infinite electrical conductivity is given by the equation $v = H/\sqrt{(4\pi\rho)}$, where v denotes the velocity, H the magnetic field, and ρ the density. The case is considered in which v and H have symmetry about an axis, and convenient forms for the equations governing axisymmetric oscillations about the stationary solution are obtained. These latter equations take their simplest forms when the initial magnetic field and fluid motions have no poloidal components. This case is considered in some detail. A.

538.56.029.6 : 621.3.011 : 621.37

5481. ON A CERTAIN OPTICAL INTERPRETATION OF THE HELMHOLTZ EQUATION. K.Bochenek and J.Plebański.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 3, 179-86 (1956).

A shortened version in English of the Polish paper abstracted in Abstr. 8286 (1956). J.S.Bell

538.561

5482. RADIATION BY PLASMA OSCILLATIONS. G.B.Field.
Astrophys. J., Vol. 124, No. 3, 555-70 (Nov., 1956).

In a homogeneous plasma having no static electric or magnetic fields the longitudinal plasma waves and the transverse electromagnetic waves are uncoupled. It is shown that in the presence of inhomogeneities they are coupled, leading to the possibility of radiation by plasma waves generated in astronomical sources. In particular, the radiation resulting from the incidence of a plasma wave on a density discontinuity is calculated. The modifications due to the presence of a static magnetic field are considered. The analysis is applied to a model of solar flare ejections having a density discontinuity; the calculated power greatly exceeds that observed for the solar radio outbursts by Wild and his collaborators. Thus there is hope that the same type of coupling, but with more realistic inhomogeneities, will provide power in the amount observed. A.

538.561 : 621.37

5483. MOLECULAR AMPLIFICATION AND GENERATION OF MICROWAVES. J.P.Wittke.
Proc. Inst. Radio Engrs, Vol. 45, No. 3, 291-316 (March, 1957).

A general introduction to the field of amplification and genera-

tion of microwaves using molecular rather than electronic processes. The basic physical properties of molecular systems as related to amplification are reviewed. The properties of molecular amplifiers, such as gain, bandwidth, saturation power, and noise figure are discussed, and several specific types of amplifiers are described. These include the molecular-beam Maser, the "hot-grid cell", amplifiers excited by r.f. pulses and by "adiabatic fast passage", and amplifiers based on multilevel molecular internal energy systems, including "optically pumped" amplifiers. Molecular amplifiers may add very little noise to the signal to be amplified: noise figures under one dB can be obtained. With suitable feedback, such amplifiers become oscillators of extremely high spectral purity. High gains can be achieved using regeneration, but bandwidths are relatively small. These range from the order of tens of kilocycles for amplifiers using a gaseous molecular system, to megacycles, using solids. Molecular amplifiers saturate at low input powers, of the order of microwatts. Variations of the devices discussed may provide a means of generating millimetre and submillimetre waves. A.

538.561 : 621.373

5484. PRODUCTION AND AMPLIFICATION OF MICROWAVES BY ATOMIC PROCESSES. J.Combrisson and C.H.Townes.
Onde élect., Vol. 36, 989-91 (Nov., 1956). In French.

A short review article describing the principle of a MASER (Microwave amplifier by stimulated emission of radiation). The first part summarizes the experiments reported by Gordon, Zeiger and Townes (Abstr. 8607/1955) on the use of a beam of NH_3 molecules where an oscillator with a frequency stability of 4×10^{-12} was constructed. The second part indicates the possibility of a solid-state version of a maser with reference to experiments reported by Combrisson, Honig and Townes in Abstr. 7546 (1956). H.Motz

538.561 : 621.373

5485. MASER OSCILLATORS. J.C.Helmer.
J. appl. Phys., Vol. 28, No. 2, 212-15 (Feb., 1957).

See preceding abstract. Two maser oscillators have been constructed and operated. The behaviour of one maser has been observed under various operating conditions by comparing it with the second maser which is used as a reference standard. The experimental setup is shown and experimental results are given. The frequency-pulling effects of the beam and the oscillation amplitude as a function of cavity-tuning are compared with the theoretically expected behaviour. It is shown that the simple behaviour predicted by theory exists only for oscillation frequencies which are well removed from line centre. The theoretical curves are obtained from a new analysis which includes the velocity distribution in the beam. A comparison is made between the velocity-distributed and uni-velocity theories. It is shown that the introduction of the velocity distribution drops the maximum beam efficiency from 1 to 0.76 and causes a region of stability to appear in the beam frequency-pulling function. A.

538.561 : 621.373

5486. NOISE IN A MOLECULAR AMPLIFIER. M.W.Muller.
Phys. Rev., Vol. 106, No. 1, 8-12 (April, 1957).

The quantum theory of noise in lossy electrical circuits is extended to systems which are not in thermal equilibrium. The theory is applied to microwave molecular amplifiers (see preceding abstract) and predicts a correction to the classically calculated noise figure which can be identified with spontaneous emission from the molecules of the active medium. The correction is small at ordinary temperatures but becomes significant at very low temperatures. A.

538.561 : 548.7

OPERATION OF A SOLID-STATE MASER MICROWAVE OSCILLATOR. See Abstr. 4876

538.565

5487. LIMITATIONS OF THE MICROWAVE CAVITY METHOD OF MEASURING ELECTRON DENSITIES IN A PLASMA. K.B.Persson.
Phys. Rev., Vol. 106, No. 2, 191-5 (April 15, 1957).

The limitations of the conventional microwave cavity method of measuring the electron density are derived. The conventional method permits the electron density to be measured over a range of approximately two decades. The upper limit of the measurement of the electron density, roughly 5×10^9 cm^{-3}, is caused by plasma resonance due to the macroscopic polarization of the plasma and by the overlapping from higher order modes. The lower limit of the measurement of the electron density, roughly 5×10^7 cm^{-3}, is determined by how accurately the resonant frequency can be measured. The macroscopic electric polarization can be eliminated and the overlapping modes suppressed by designing the cavity so that the probing microwave field and the plasma have rotational symmetry around the same axis. The electric polarization limit is then replaced by a magnetic polarization limit and the available range is increased approximately one additional decade at 3000 Mc/s. By decreasing the frequency from 3000 Mc/s to 1 Mc/s and by measuring the Q or the losses of the plasma in a properly designed solenoid instead of a cavity the magnetic polarization limit can be raised even more. At 1 Mc/s and at a pressure of 1 mm Hg the electron density corresponding to the magnetic polarization limit is 10^{15} to 10^{16} cm^{-3}. The lower limit for the measurable electron density or the conductivity is determined by the sensitivity of the detecting arrangement, and the noise originating in the electron–ion plasma and is probably 10^4 to 10^5 times less than the maximum measurable electron density. A.

538.565

5488. MICROWAVE MEASUREMENTS OF HIGH ELECTRON DENSITIES. S.J.Buchsbaum and S.C.Brown.
Phys. Rev., Vol. 106, No. 2, 196-9 (April 15, 1957).

The conventional microwave method for measuring plasma electron densities is limited in its validity to relatively low concentrations ($\sim 10^9$ cm^{-3}). Following a theoretical development by Persson (preceding abstract), a method is presented whereby much higher densities can be measured. The method is based on eliminating the effect of a.c. space-charge on the probing microwave field. This is accomplished by ensuring that the electric field be everywhere perpendicular to electron-density gradients. A discussion is presented on the effect of neighbouring modes on the measuring mode in a microwave cavity. A.

538.566 : 621.372.8

5489. A NOTE ON THE EXCITATION OF SURFACE WAVES. A.L.Cullen.
Proc. Instn Elect. Engrs, Monogr. 239R, publ. May, 1957, 3 pp.
To be republsihed in Part C.

An extension of results on the launching efficiency of surface waves obtained in a previous paper (Abstr. 3686/1954). In particular, a study is made of the effect on the launching efficiency curves of varying the ration k_1/k, which is a measure of the surface reactance of the guiding surface. A.

538.566

5490. RESONANCE CURVES OF THE DOUBLE RESONANCE AT A REFLECTION GRATING. L.N.Deryugin and G.Kh.Fridman.
Dokl. Akad. Nauk SSSR, Vol. 111, No. 6, 1209-11 (1956). In Russian.

Three earlier papers have given a description of the phenomenon and a treatment of the wave equations relating thereto (Abstr. 3683/1954; Dokl. Akad. Nauk SSSR, Vol. 93, No. 6, 1003, 1953; Abstr. 2444/1957). The current paper is devoted to deriving approximate solutions for the resonance curves of wave and field amplitudes. C.R.S.Manders

538.566

5491. REFLECTION OF PLANE-POLARIZED, ELECTROMAGNETIC RADIATION FROM AN ECHELETTE DIFFRACTION GRATING. W.C.Meecham and C.W.Peters.
J. appl. Phys., Vol. 28, No. 2, 216-17 (Feb., 1957).

A variational method is used to calculate the distribution of energy reflected from an echelette diffraction grating. Experiments performed using a klystron generating 3.2 cm electromagnetic waves which impinge upon a large scale grating agree with the calculations to within a few percent, the error being that expected from the variational formulation. A.

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11

5492. TWO-CENTRE INTEGRALS IN SOLIDS. M.Suffczyński.
Acta phys. Polon., Vol. 15, No. 5, 287-94 (1956).

Fletcher and Wohlfarth's method of calculating the energy two-centre integrals in solids is described in detail. A.

539.11 : 548.7

5493. ELECTRON AND LATTICE CONDUCTION IN METALS. I.I.Hanna and E.H.Sondheimer.
Proc. Roy. Soc. A, Vol. 239, 247-66 (Feb. 26, 1957).

The theory of the transport phenomena in metals is re-examined, the departure from equilibrium of both the electron and the lattice distribution functions being simultaneously taken into account in a consistent fashion. Simple expressions are derived for the conduction magnitudes which are exact at sufficiently high and sufficiently low temperatures and which are assumed to be approximately valid for all temperatures. The behaviour of the terms which arise from the non-equilibrium of the lattice depends upon the relative importance of the various causes responsible for scattering the lattice vibrations. In the case of the electrical conductivity these terms are estimated to be small in general, but they may have a bearing on some of the observed resistance anomalies at very low temperatures. Further, while the present theory gives nothing new in the case of the thermal conductivity, which is given by the sum of the usual electronic and lattice conductivities, the behaviour of the thermoelectric power is found to be profoundly modified, the non-equilibrium of the lattice leading in general to a considerably increased value which may show a complex temperature variation. The theory can account for the observed thermoelectric power of sodium at low temperatures and it suggests reasons for the complex character of the thermoelectric behaviour of metals in general, although in the present form the theory is not sufficiently general to account for all the observed anomalies even in the monovalent metals. A.

539.11

5494. DETERMINATION OF THE VALENCE BAND IN METALLIC SODIUM BY THE PARZEN VARIATIONAL METHOD. M.Miąsek.
Bull. Acad. Polon.Sci. Cl. 3, Vol. 4, No. 7, 453-6 (1956).

The calculation is similar to that used by Wainwright and Parzen (Abstr. 2859/1954) for metallic lithium. With one exception, the energies thus obtained for various points on the dodecahedron surrounding the first Brillouin zone compare closely with those derived by Howarth and Jones (Abstr. 5218/1952).

A.J.Kennedy

539.11 : 537.311.31 : 537.531 : 535.343

5495. BRILLOUIN ZONES, ELECTRICAL CONDUCTIVITY OF METALS AND X-RAY K ABSORPTION SPECTRA. C.Kurylenko.
Cahiers de Phys., No. 70, 34-40 (June, 1956). In French.

Concludes this series of articles (see Abstr. 5264/1956). The type of investigation described in Abstr. 7228 (1955) is applied to Al and some compounds of Fe. D.M.Edwards

539.11

5496. ELECTRONIC BAND STRUCTURE IN GRAPHITE. M.Yamazaki.
J. chem. Phys., Vol. 26, No. 4, 930-4 (April, 1957).

The tight-binding approximation is applied to a study of graphite, using Slater atomic orbitals for the carbon atom with nuclear charge $2\delta = 3.18$. The 16 x 16 determinantal secular equation for the energy is reduced by a group-theoretical treatment of the spatial symmetry at certain special values of the wave vector k. The calculated results are that valence and conduction π bands overlap very slightly to each other at the corner points of the first Brillouin zone — at the wave vector $k = 2\pi(\frac{1}{2}c, \frac{2}{3}a, 0)$ —, σ-and π-valence bands are separated, the σ and π band width is about 16 eV, 1 eV, respectively, and the ionization energy (work function) is about 9 eV. A.

539.11 : 538.11

5497. CONDUCTION BAND POLARIZATION IN DILUTE ALLOYS. E.W.Hart.
Phys. Rev., Vol. 106, No. 3, 467 (May 1, 1957).

It is shown that any conduction band magnetization produced by electron interaction with dilute impurities in a metal is spatially localized to the immediate vicinity of the impurity atoms. A.

539.11

5498. ENERGY OF FORMATION OF VACANCIES IN COPPER AND GOLD. P.Jongenburger.
Phys. Rev., Vol. 106, No. 1, 66-9 (April 1, 1957).

From the anomalous rise of the thermal expansion near the melting point, a value of about 0.7 eV for the energy of formation of vacancies in copper and gold is found. A.

539.11

5499. ON THE PERIOD OF OUT-OF-STEP OF ORDERED ALLOYS WITH ANTI-PHASE DOMAIN STRUCTURE. K.Fujiwara.
J. Phys. Soc. Japan, Vol. 12, No. 1, 7-13 (Jan., 1957).

The period of out-of-step of ordered alloys with antiphase domain structure, measured in atomic distance, is generally not an integer, in spite of sharp splittings of superlattice reflections. This fractional property of the period has been examined theoretically. The general treatment of this problem has shown that a regular and uniform arrangement of the different periods of antiphase domains can explain the fractional value of the period. The results of numerical calculations for some models suggest, however, that complete regularity in arrangement is not always necessary but only uniformity is essential for the interpretation of the diffraction patterns. A.

539.11 : 548.7

MAGNETIC ENERGY LEVELS OF ELECTRONS IN METALS.
See Abstr. 4871

MOLECULES 539.13

539.13

5500. INTERMOLECULAR POTENTIALS FOR UNLIKE INTERACTION ON EXP-SIX MODEL. K.P.Srivastava.
J. chem. Phys., Vol. 26, No. 3, 579-81 (March, 1957).

The potential parameters for the unlike pairs of molecules A-He, A-Xe and Ne-Xe have been determined for the "exp-six" model from the temperature dependence of thermal diffusion of these gas mixtures following the method developed earlier by Srivastava and Madan. Unlike the graphical method of Srivastava and Srivastava a purely computational method has been employed here for determining the parameters α_{12} and ϵ_{12}. First coupled values of α_{12} and ϵ_{12} were determined by neglecting the temperature variation of the "g" factor and using Kihara's first approximation formula. Then the absolute value of the "g" factor was calculated at a fixed temperature for various values of α_{12} and that value of α_{12} selected which gave the experimental value of the thermal diffusion factor α_T. Precise value of ϵ_{12} was determined by taking into account the temperature variation of "g". The values of the potential parameters α_{12}, ϵ_{12}, and $(r_m)_{12}$ thus obtained were found to reproduce satisfactorily the experimental data on thermal diffusion except for very low temperatures where T^* is less than 1.5 and the "exp-six" law probably does not hold. A.

539.13

5501. SHORT-RANGE INTERMOLECULAR FORCES. II. H_2–H_2 AND H_2–H. E.A.Mason and J.O.Hirschfelder.
J. chem. Phys., Vol. 26, No. 4, 756-66 (April, 1957).

The energy of interaction between two hydrogen molecules and between a hydrogen atom and a hydrogen molecule are calculated using a new method (see Pt I, Abstr. 3478/1957) for approximating the 3- and 4-centre integrals. The results are in good agreement with previous calculations of Margenau and with existing experimental data. The multiple exchange and zeroeth order perturbation make the calculations somewhat complicated. Although good results were obtained by de Boer, who neglected these terms, the success of such a procedure depends on a fortuitous cancellation of errors. Following de Boer's procedure for the case of a hydrogen atom–hydrogen molecule interaction, very poor results were obtained. A.

539.13 : 535.338.334

5502. FOREIGN GAS PRESSURE BROADENING OF LINEAR MOLECULES. K.L.Perkins, A.V.Bushkovitch and L.J.Kieffer.
J. chem. Phys., Vol. 26, No. 4, 779-81 (April, 1957).

Calculations have been made for the general cases of a linear polar molecule interacting with the following foreign molecules: monatomic, linear nonpolar, and linear polar. The interactions of importance are the first-order London dispersion force for the first two cases and the combined dipole–quadrupole, quadrupole–quadrupole, and first-order London dispersion forces for the third case. In the case of OCS with He, O_2, and N_2O the calculations yield 3.22, 5.41, and 7.41 A, respectively, in reasonable agreement with experiment. A.

539.

5503. INTERMOLECULAR POTENTIAL BETWEEN LARGE MOLECULES. A.Isihara and R.Koyama.
J. Phys. Soc. Japan, Vol. 12, No. 1, 32-9 (Jan., 1957).

The intermolecular potential between spherical polyatomic molecules is calculated, assuming the Lennard-Jones potential between atoms of polyatomic molecules. Owing to the distribution of atoms in polyatomic molecules the degree of infinity of potential is lowered when two polyatomic molecules approach each other. In the case of uniform distribution of atoms in polyatomic molecules

he degree is lowered by 5 orders and the minimum value of the potential is proportional to the radius of polyatomic molecule and to the square of the density of the atoms. At large intermolecular distance, the result of calculation of this case coincides with the results of Atoji and Lipscomb and of Hamaker. Calculation for a parabolic distribution of atoms is also given. The temperature and molecular weight dependences of the second virial coefficient of high-polymer solutions are explained with the aid of calculated potential function. A.

539.13 : 533.7

5504. INTERMOLECULAR FORCES IN AIR. A.S.Friedman. J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 93-4 (Feb., 1957).

The intermolecular force constants for a 6–12 Lennard-Jones potential model have been computed for air from second virial coefficients derived from experimental pressure–volume–temperature measurements. Nitrogen–oxygen interaction second virial coefficients and interaction force constants have been derived. A.

539.132 : 535.333

5505. LABORATORY DETERMINATION OF RELATIVE TRANSITION PROBABILITIES OF DIATOMIC MOLECULES. II. THE SWAN SYSTEM ($^3\Pi_g$-$^3\Pi_u$) OF THE C_2 MOLECULE. J.G.Phillips. Astrophys. J., Vol. 125, No. 1, 153-162 (Jan., 1957).

For Pt I, see Abstr. 5440 (1954). Laboratory measurements have been carried out of the relative transition probabilities of the two most intense bands of each of the $\Delta v = +1$, $\Delta v = 0$, and $\Delta v = -1$ sequences, at 4737, 5165, and 5636 A, respectively. The determinations involved the measurement of rotational features in short spectral regions occupied by the two bands in each sequence. This procedure avoids some of the sources of systematic error that may have been present in earlier studies. A.

539.132

5506. THE EFFECT OF THE TERMS NEGLECTED IN THE BORN–OPPENHEIMER APPROXIMATION ON THE CALCULATION OF INFRARED BAND INTENSITIES. S.Bratož. C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1493-5 (Nov. 12, 1956). In French.

Theoretical. A perturbation analysis shows that such effects can be taken into account by replacing the dipole moment in the usual formulae by an effective dipole moment calculated from the Born–Oppenheimer solution. J.Hawgood

539.132

5507. VIBRATIONAL INTENSITIES. VII. ETHANE AND ETHANE-d_6. I.M.Nyquist, I.M.Mills, W.B.Person and B.Crawford, Jr. J. chem. Phys., Vol. 26, No. 3, 552-8 (March, 1957).

For Pt VI, see Abstr. 3488 (1957). Absolute intensity measurements have been made on the fundamental vibrations of C_2H_6 and C_2D_6, using the extrapolation method of Wilson and Wells and using nitrogen at pressures up to 50 atm to broaden the bands. The absorption coefficient was integrated against the logarithm of the frequency. Normal coordinates were calculated from the potential function of Hansen and Dennison, and were used to interpret the results in terms of quantities $(\partial p/\partial S_j)$ giving the change of dipole moment with respect to the symmetry coordinates S_j. Consistency of data between the isotopes was used both to eliminate ambiguities in the interpretation, and as a criterion in separating overlapping pairs of absorption bands. The results have been interpreted in terms of bond effective moments. A.

539.132

5508. PARTITION FUNCTION FOR INTERNAL ROTATION IN METHANOL AND SIMILAR MOLECULAR MODELS. J.O.Halford. J. chem. Phys., Vol. 26, No. 4, 851-5 (April, 1957).

Methanol falls outside the range of variables within which the internal rotator partition function and its required derivatives have been dependably calculated by the relatively simple methods of Pitzer and Gwinn. For such cases, Ivash, Li and Pitzer have proposed a detailed, general formulation of potential extreme accuracy. It is shown here that their partition function, obtained by integration over functions which are not unique for the model, can have two formally different values. Elimination of an ambiguity from their derivation leads back to an earlier and simpler method developed empirically by Halford, without, however, establishing this method for the general case. A very simple derivation, which obviously gives answers of readily determined accuracy for a widely distributed set of special cases, is presented. It is shown that the Ivash–Li–Pitzer formulation gives accurate answers under specifiable conditions. It is also deduced that a considerable extension of the Pitzer–Gwinn tables, at a high level of accuracy, sufficient to cover all likely cases of interest, is possible without serious increase in the detail of calculation. Such an extension would solve the general case in a practical sense. A.

539.132

5509. POTENTIAL CONSTANTS OF NITROUS ACID. A.Palm. J. chem. Phys., Vol. 26, No. 4, 855-9 (April, 1957).

A normal coordinate treatment was carried out using a general quadratic potential function. Possible sets of force constants were evaluated on the basis of previously observed vibrational bands. The most probable range for the potential constants was established by means of bond order criteria and distributions of potential and kinetic energies among the internal coordinates. A.

539.132

5510. EVALUATION OF FORCE CONSTANTS FROM RAMAN EFFECT DATA: MOLECULES OF THE TYPE XY_3Z. K.Venkateswarlu and S.Sundaram. J. Phys. Radium, Vol. 17, No. 10, 905-6 (Oct., 1956). In French.

The force constants for $POCl_3$, $POBr_3$, $PSCl_3$, $SiHCl_3$, $SiHBr_3$, $SnBrCl_3$, $SnClBr_3$, and $SiClBr_3$ have been calculated by Wilson's F–G matrix method. In each case the six observed frequencies are used to choose a potential function and calculate six force constants. G.Allen

539.132

5511. DESIGNATION OF THE INTERNAL VIBRATIONAL MOVEMENTS OF THE ATOMS OF A MOLECULE. J.Cabannes. J. Phys. Radium, Vol. 17, No. 10, 910 (Oct., 1956). In French.

French equivalents are proposed for the following vibrational modes: stretching (tension), bending (flexion), twisting (torsion), rocking (tangage), wagging (roulis). G.Allen

539.132

5512. LIFETIME MEASUREMENTS OF METASTABLE STATES IN MOLECULAR NITROGEN. W.Lichten. J. chem. Phys., Vol. 26, No. 2, 306-13 (Feb., 1957).

The molecular beam method for the measurement of the lifetime of metastable states has been improved by the introduction of differential pumping, control of the energy of the bombarding electrons, and use of a movable detector. A lower limit of 10^{-2} sec is obtained for the lifetime of the $A\,^3\Sigma_u^+$ state of N_2, in closer agreement with spectroscopic observations than the previous work of Muschlitz and Goodman. The measured value of the lifetime of the $a\,^1\Pi_g$ state of N_2 is $(1.7 \pm 0.3) \times 10^{-4}$ sec. Some new observations on metastable states of the rare gas atoms, A, Kr, and Xe; CO and H_2 are mentioned briefly. A.

539.132 : 523.67

ANALYSIS OF NH_2 BANDS OBSERVED IN THE VISIBLE REGION OF THE AMMONIA SPECTRUM, FROM THE STUDY OF COMETARY SPECTRA. See Abstr. 4992

539.132

5513. PROTON MAGNETIC RESONANCE OF SOLID SYM-TETRACHLORO AND TETRABROMOETHANE. M.Takeda and H.S.Gutowsky. J. chem. Phys., Vol. 26, No. 3, 577-9 (March, 1957).

The proton magnetic resonance line shapes have been observed in solid sym-tetrachloroethane and sym-tetrabromoethane. The second moments of the absorption lines provide unambiguous assignments of the molecular forms. The results confirm the formation by $CHBr_2CHBr_2$ of crystals of either trans- or of gauche-molecules, depending upon thermal treatment, with the trans-crystals stabler at low temperatures. Only the gauche-form of solid $CHCl_2CHCl_2$ could be prepared. A.

539.132

5514. ELECTRON SPIN RESONANCE AND THE STRUCTURE OF FREE RADICALS. S.I.Weissman, T.R.Tuttle, Jr and E.de Boer. J. phys. Chem., Vol. 61, No. 1, 28-31 (Jan., 1957).

The hyperfine structure of the electron spin resonance of a polyatomic free radical yields information concerning the electronic structure of the radical. The hyperfine interaction is conveniently separated into an isotropic and a non-isotropic part. Only the former is observed in fluid solutions. From it the value of the electron spin density at the position of each magnetic nucleus in the molecule may be deduced. The spin density at $\vec{r_0}$ is the expectation value of $\sum_k \sigma_{zk}\delta(\vec{r_k} - \vec{r_0})$, where σ_{zk} is the Pauli operator for z-component of spin of the k-electron and $\vec{r_k}$ its position. The non-isotropic part is observable in detail in dilute single crystals and in certain average properties in rigid glassy solutions. It yields expectation values of $\sum_k \sigma_{zk}(3\cos^2\theta_k - 1)/|\vec{r_k} - \vec{r_0}|^3$, where θ_k is the angle between $\vec{r_k} - \vec{r_0}$

and the external magnetic field. If the electronic wave-function of a free radical is represented by a single configuration consisting of filled orbitals and one singly occupied orbital, the spin density at each point is proportional to the square of the amplitude of the singly occupied orbital at that point. In planar aromatic free radicals the unpaired electron is usually placed in a π-orbital which yields zero spin density in the plane of the molecule. Nevertheless, experiments reveal non-vanishing spin densities in the molecular plane for many aromatic free radicals. These are interpreted through admixture of configurations containing unfilled σ-orbitals. The contribution of such an admixture to spin density is linear in the amplitude of the admixture. The above considerations apply to the proton and C^{13} hyperfine splittings in negative ion hydrocarbons, triarylmethyls and other free radicals. Several examples are discussed. A.

539.132

5515. ZEEMAN EFFECT ON THE QUADRUPOLE SPECTRUM OF IODIC ACID. R.Livingston and H.Zeldes.
J. chem. Phys., Vol. 26, No. 2, 351-8 (Feb., 1957).

The pure quadrupole spectrum of I^{127} in iodic acid has been observed at several temperatures. At 22° C the z component of the quadrupole coupling is 1126.9 Mc/s and η, the asymmetry parameter is 0.4505. Zeeman studies on the low frequency transition ($\pm 1/2 \rightarrow \pm 3/2$) showed an intensity effect that depended on the orientation of the crystal in the r.f. coil. Extra Zeeman components were present that resulted from a proton interaction, and the study of these essentially located the hydrogen in the crystal lattice. Zeeman studies on the high frequency transition ($\pm 3/2 \rightarrow \pm 5/2$) showed four components for each type of iodine atom, the two not normally present unless η is large were weak. The splittings of the levels were uniquely assigned and the directions of the principal axes computed. A.

539.132

5516. NUCLEAR MAGNETIC RESONANCE IN GUANIDINIUM ALUMINUM SULFATE HEXAHYDRATE. D.W.McCall.
J. chem. Phys., Vol. 26, No. 3, 706-7 (March, 1957).

The decrease of second moment for the proton resonance spectrum of guanidinium aluminium sulphate hexahydrate from 26.9 gauss^2 at 77° K to 19.8 gauss^2 at 199° K indicates motional narrowing at 199° K probably due to rotation of the guanidinium.

D.H.Whiffen

539.132

5517. ELECTRIC QUADRUPOLE INTERACTIONS OF DEUTERONS AND MOLECULAR MOTION IN $Li_2SO_4.D_2O$.
S.Ketudat and R.V.Pound.
J. chem. Phys., Vol. 26, No. 3, 708-9 (March, 1957).

Deuteron magnetic resonance experiments on $Li_2SO_4.D_2O$ show the existence of quadrupole coupling, and at −125° C with coupling constant 237 ± 10 kc/s and asymmetry factor 0.14 ± 0.04, the maximum of the coupling tensor is along the O–D bonds. At room temperature the coupling is 123 ± 3 kc/s, asymmetry 0.80 ± 0.02; the details suggest that at this temperature the D_2O molecule flips about the DOD angle bisector which is the direction of the minimum tensor component. D.H.Whiffen

539.132

5518. NUCLEAR MAGNETIC RELAXATION IN 1,2-DICHLOROETHANE. S.Linder.
J. chem. Phys., Vol. 26, No. 4, 900-5 (April, 1957).

Analysis of thermal relaxation times in solid and liquid 1,2-dichloroethane suggests the following: (1) The mechanism causing thermal relaxation in the solid is a partial rotation of the molecule about the molecular axis (which is approximately the C–C axis) against a potential barrier of about 1.5 kcal per mole. (2) It is likely that the narrowing of the resonance line is a result of the completion of this partial motion. (3) At the melting point, a drop in the thermal relaxation time of about an order of magnitude occurs. (4) In the liquid, a new motion has set in, characterized by a lower activation energy (roughly 0.6 kcal/mole). This motion may be end-over-end tumbling. The spin–lattice relaxation time ("thermal" relaxation time) in the solid ranges between 1 and 20 sec, and its length permits its measurement by a method which is slightly different from the conventional technique. This technique utilizes the fact that, immediately upon application of the radiofrequency field, the magnetization of the sample decays with a time which can be related to the thermal relaxation time and to the strength of the radiofrequency field. The measurement is a direct measurement of a characteristic time of the sample, and is therefore more reliable than the conventional indirect measurement. The technique also enables one to calibrate the radiofrequency field more easily. A.

539.13

5519. EFFECT OF IMPURITIES ON THE Cl^{35} QUADRUPOLE RESONANCE IN C_6H_5Cl. R.E.Michel and R.D.Spence.
J. chem. Phys., Vol. 26, No. 4, 954-5 (April, 1957).

An investigation of the reduction of quadrupole signal in C_6H_5Cl per mole of impurity. It is found that the number of C_6H_5Cl molecules removed from the resonance observed is proportional to the van der Waals' radii of para substitutents in the aromatic impurities and is independent of the net dipole moment. D.H.Whiffe

539.13

5520. NMR SPECTRA OF METAL ALKYLS; MAGNETOGYRIC RATIO OF Pb^{207}. E.B.Baker.
J. chem. Phys., Vol. 26, No. 4, 960-2 (April, 1957).

A detailed account of high resolution, 30 Mc/s nuclear magnet resonance spectra of $AlCl(C_2H_5)_2$ and $Pb(C_2H_5)_2$. In the latter, the proton lines coincide except when split by the Pb^{207} nucleus. This structure collapses in a double resonance experiment which gives $\nu Pb^{207}/\nu H^1 = 0.2092198 \pm 10$. D.H.Whiffe

539.13

5521. NUCLEAR MAGNETIC RESONANCE SPLITTINGS IN VERY WEAK FIELDS (35-15 GAUSS). D.P.Roux and G.J.Bene.
J. chem. Phys., Vol. 26, No. 4, 968-9 (April, 1957).

Measurements on the splitting of the proton magnetic resonanc spectra of $HPO(OH)_2$ and related compounds at 15-35 gauss are in complete agreement with those obtained at higher field strengths. D.H.Whiffe

539.132 : 532

5522. DOUBLE-QUANTUM TRANSITIONS IN NUCLEAR MAGNETIC RESONANCE SPECTRA OF LIQUIDS. J.I.Kaplan and S.Meiboom.
Phys. Rev., Vol. 106, No. 3, 499-501 (May 1, 1957).

Observations of double-quantum transitions are reported. Th presence of spin–spin interaction causes the double-quantum lines to form multiplets. A theoretical explanation of the multiplet stru ure is given.

539.1

5523. ON THE CALCULATION OF ENERGY LEVELS AND WAVE-FUNCTIONS IN THE METHOD OF THE LINEAR COMBIN ATION OF ATOMIC ORBITALS. J.L.Masse.
Cahiers de Phys., No. 70, 30-3 (June, 1956). In French.

Brief description of the perturbation method of calculating properties of a molecule from those of a related one, in the simpl LCAO framework, giving iteration procedures. See Abstr. 4772, (1956). J.Hawgo

539.1

5524. CONTRIBUTION TO THE STUDY OF THE METALLIC MODEL. A.Marchand and A.Pacault.
Cahiers de Phys., No. 75-76, 66-7 (Nov.-Dec., 1956). In French.

It is suggested that an effective electron mass be used as a variable parameter in the metallic approximation for organic mol cules. An application to the ultraviolet absorption spectra of poly methine dyes is mentioned. D.M.Edwa

539.132 : 539.1

5525. EQUIVALENT ORBITAL BOND MOMENTS. APPLICATIONS TO CARBON DIOXIDE AND WATER. W.C.Hami
J. chem. Phys., Vol. 26, No. 2, 345-51 (Feb., 1957).

Self-consistent field molecular orbitals for CO_2, H_2O and the B_2H_4 skeleton of diborane have been transformed into equivalent orbital representations, and bond moments have been defined as t dipole moments of the corresponding equivalent orbitals. If a ma imum localization criterion is imposed and if hybrid moments (atomic dipole terms) on central atoms are omitted, one obtains moments of 2.6D(C^+O^-) in CO_2, 1.4D/O^-H^+) in water, and 2.03D(B in a line perpendicular to the B–B bond in diborane. The treatm of water does not seem to allow a separation of well-localized bo and lone-pair moments with the proper directional properties. T bond moment of C–H in methane, according to these criteria, is 0.6D(C^-H^+). It is concluded that the method is a valid approach t the problem of nonempirical calculation of bond moments in poly atomic molecules.

539

5526. COMPLETE π-ELECTRON TREATMENT OF THE BUT DIENE MOLECULE AND ION. J.Fain and F.A.Matsen.
J. chem. Phys., Vol. 26, No. 2, 376-9 (Feb., 1957).

The complete VB treatments of the π-electron energy levels the butadiene molecule and ion are presented. The results for t molecule are in agreement with those of a SCF–CI calculation. is found that the energy of the single structure, $H_2C{=}CH{-}CH{=}C$ is very close to the result of the complete calculation. An expre sion for the ionization potential of the molecule is obtained.

539.132

5527. NEW APPROACH TO THE QUANTUM-MECHANICAL ANALYSIS OF THE ELECTRONIC STRUCTURES OF MOLECULES. THE METHOD OF DEFORMED ATOMS IN MOLECULES. T.Arai.
J. chem. Phys., Vol. 26, No. 3, 435-50 (March, 1957).

A modification of Moffitt's method of atoms in molecules is here proposed. In this treatment, the modified atomic functions X are introduced, which are made up from the exact eigenfunctions of atoms modified by correction factors so as to take account of the deformation of atoms in molecules. The advantage of these basic functions X is as follows. Firstly, the difficulty caused by the correlation energy in atoms can be removed by the use of the experimental atomic term values just as in Moffitt's method. Secondly, the common effective charges for neutral and ionic structures can be applied for the convenience of calculating the interaction operators, which sometimes produces serious errors in Moffitt's method. Moreover the improvement on the original Heitler–London treatment corresponding to Wang's or Weinbaum's work for the hydrogen molecule can be expected. Then, it is discussed how to determine these modified atomic functions in order that the results appertain to the good range in spite of the rather simple calculation. The energy loss of atoms in molecules, induced by the deformation, is corrected, and the interatomic interaction energy is calculated by the use of the approximate functions composed of the orbital functions, where the molecular orbital method can be utilized for saving the difficulty of the higher order permutations. Then the unsatisfactory results, obtained in the calculation of Li_2 by utilizing the common effective charges in Moffitt's method, are improved. A.

539.132

5528. APPLICATION OF THE METHOD OF DEFORMED ATOMS IN MOLECULES TO THE HYDROGEN MOLECULE. T.Arai.
J. chem. Phys., Vol. 26, No. 3, 451-4 (March, 1957).

The method of deformed atoms in molecules, (preceding abstract) is applied to the hydrogen molecule. Two structures, the neutral and ionic ones, are considered. It is assumed that the best approximate functions are made up from the hydrogen-like functions, and favourable correction factors are sought so as to bring about the results appertaining to the good range. Energy drops of 1.5 ~ 1.7eV are then obtained, which are satisfactory results as compared with that of 0.16 eV in Moffitt's method. Discussion is given about the function of the ionic term, in which the axial correlation is taken into account. A.

539.132 : 541.57

5529. FLEXIBILITY OF CHEMICAL BOND AS REVEALED BY THE ROCKING FREQUENCIES IN ETHYLENE. T.Shimanouchi.
J. chem. Phys., Vol. 26, No. 3, 594-601 (March, 1957).

The CH_2 rocking frequencies in ethylene are explained by taking the flexibility of the C–C bond into account. Mathematical expressions for the bond flexibility are dealt with. The difference between the Urey–Bradley field and the orbital force field is discussed and it is concluded that in the case of ethylene and its derivatives the inclusion of simple correction terms in the Urey–Bradley field can also cover the case of the orbital force field. A.

539.132

5530. MOLECULAR SCREENING CONSTANTS. B.Musulin.
J. chem. Phys., Vol. 25, No. 5, 801-3 (Nov., 1956).

An empirical method is suggested for the calculation of molecular screening constants. The method is based upon the values of the screening parameter in atomic orbitals. Comparisons are made with some variational calculations. A.

539.132

5531. ELECTRONIC SPECTRA OF CYCLIC AROMATIC HYDROCARBON RADICALS AND IONS. H.C.Longuet-Higgins and K.L.McEwen.
J. chem. Phys., Vol. 26, No. 4, 719-23 (April, 1957).

The electronic spectra of a series of cyclic unsaturated radicals and ions containing from three to eight carbon atoms have been calculated by a semiempirical molecular orbital method. A.

539.132

5532. INTERRELATIONS OF QUANTUM-MECHANICAL QUANTITIES CONCERNING CHEMICAL REACTIVITY OF CONJUGATED MOLECULES. K.Fukui, T.Yonezawa and C.Nagata.
J. chem. Phys., Vol. 26, No. 4, 831-41 (April, 1957).

It is attempted to disclose the interrelations underlying the parallelism found in several quantum-mechanical methods previously proposed to explain chemical reactivity in conjugated molecules. This is carried out mathematically in alternant hydrocarbons and hetero-alternant molecules mainly by the use of Coulson's integral formulae. In an alternant hydrocarbon, provided a condition is satisfied between minors of the secular determinant, the orders of reactivity of each position predicted by the self-polarizability, free valence, superdelocalizability, Wheland's localization energy, and Dewar's approximate localization energy by NBMO are shown to be in complete agreement with one another. The relation of the frontier electron density and superdelocalizability is discussed. It is also demonstrated that a nonperturbation treatment for the so-called static method leads to the same conclusion as the perturbation treatment. The parallelism of various quantities is discussed in their relation to the effect of heteroatom in hetero-alternant molecules. A.

539.132

5533. APPLICATION OF SELF-CONSISTENT MOLECULAR ORBITAL METHODS TO π-ELECTRONS. J.A.Pople.
J. phys. Chem., Vol. 61, No. 1, 6-10 (Jan., 1957).

The simplest molecular theory of the structure of π-electron systems is based on an incompletely defined Hamiltonian which does not include electron interaction. In this paper a self-consistent method is described in which systematic approximations are made for the electron repulsion integrals. The theory is applied to the following properties of hydrocarbons: (1) resonance energies; (2) ionization potentials and electron affinities of molecules and radicals; (3) bond orders and bond lengths; (4) relative stability of radicals and carbonium ions; (5) charge distribution in ions. It is found that, for a satisfactory theory of some of these properties, electron interaction terms must be included in the treatment. A.

539.132

5534. MOLECULES WITH ALMOST SPHERICAL SYMMETRY. R.A.Buckingham and C.Carter.
J. phys. Chem., Vol. 61, No. 1, 19-23 (Jan., 1957).

A comparison is made of the calculated properties of tetrahedral molecules derived (a) by the Thomas–Fermi method, (b) by orbital methods, using the approximation of spherical symmetry. The difficulties associated with a more precise treatment of such molecules are discussed with particular reference to CH_4, CCl_4 and CF_4. It is concluded that if satisfactory results for most molecular properties are to be obtained, both electron exchange effects and departure from spherical symmetry must be allowed for. A study of the PH_5 molecule with assumed bipyramidal structure is described, showing that the peripheral atoms effectively contract the 3d-orbitals and thereby promote the formation of pentavalent bonds. A.

539.132 : 541.57

5535. PRESENT SITUATION OF QUANTUM CHEMISTRY. P.E.Löwdin.
J. phys. Chem., Vol. 61, No. 1, 55-68 (Jan., 1957).

It is pointed out that the nature of the covalent bond may be understood only by means of modern quantum mechanics. The introduction of Planck's quantum of action h leads to Heisenberg's uncertainty relation for a single particle which indicates that the idea of the existence of the classical orbits has to be abandoned. In a many-electron system there is then no longer any possibility for identifying the individual particles, and all chemically and physically measurable results must hence be independent of the labelling of the particles. It is shown that this symmetry law leads to a new form of energy, the "exchange energy", which among other things also explains the chemical bond according to Heitler and London. A brief survey is given of the development of quantum chemistry, and the main problems of actual interest in the valence bond method and in the molecular orbital theory are discussed. The simplification in the interpretations recently obtained by introducing density matrices and natural spin-orbitals is finally described. A.

539.132

5536. DISSOCIATION ENERGIES OF CARBON MONOXIDE AND NITROGEN FROM REFLECTED SHOCK WAVE STUDIES. J.P.Toennies and E.F.Greene.
J. chem. Phys., Vol. 26, No. 3, 655-62 (March, 1957).

Reflected shock velocities have been measured in pure nitrogen, pure carbon monoxide, dilute mixtures of these gases in argon, and in pure argon. The results agree well with the calculations based on the dissociation energies, $D(N_2) = 9.76$ eV and $D(CO) = 11.1$ eV; but not with $D(N_2) = 7.38$ eV and $D(CO) = 9.14$ eV. An acceleration of the reflected shock in nitrogen and carbon monoxide is attributed to vibrational relaxation in the incident shock. Although some deviations from ideal behaviour due to energy and momentum losses are shown to be present, the results indicate that equilibrium is very nearly attained, and that shock tube measurements can provide useful high-temperature thermodynamic information. A.

539.133 : 535.343

5537. MICROWAVE SPECTRUM, STRUCTURE, AND DIPOLE MOMENT OF s-trans ACROLEIN. R.Wagner, J.Fine, J.W.Simmons and J.H.Goldstein.
J. chem. Phys., Vol. 26, No. 3, 634-7 (March, 1957).

The microwave spectrum of acrolein has been studied in the 18-37 kMc/s region. A series of R-type transitions was identified for the ground and three excited torsional states of the s-trans isomer and these spectra were successfully fitted in the rigid rotor approximation. Using the ground-state moments and additional electron diffraction data a reasonable though not unique structure has been obtained. The torsional frequency was found to be 200 ± 50 cm^{-1} from relative-intensity measurements, and a lower limit of 2300 cal was estimated for the barrier hindering trans-cis conversion. The dipole moment for the ground state was found to be 3.11 ± 0.04 d, oriented about 14^0 from the carbonyl group. The results obtained and the absence of a strong s-cis spectrum establish the s-trans isomer as the predominant form. A.

539.133

5538. CALCULATION OF DIPOLE DERIVATIVES FROM INFRARED REFLECTION SPECTRA OR RAMAN SPECTRA OF CRYSTALS. C. Haas and D.F.Hornig.
J. chem. Phys., Vol. 26, No. 3, 707 (March, 1957).

Details the theory for obtaining, $\delta\mu/\delta$ Q, the dipole moment derivative for normal vibrations of molecular groupings in a crystal either from the reflection spectrum or from the Raman spectrum. Some values based on literature data are quoted and these agree well with absorption measurements when available. D.H.Whiffen

539.133 : 535.343

DIPOLE MOMENTS OF BENZENE MOLECULE. See Abstr. 5200

539.133 : 535.343

STRUCTURE OF SULFURYL FLUORIDE. See Abstr. 5201

539.133

5539. STRUCTURE OF CH_2. G.A.Gallup.
J. chem. Phys., Vol. 26, No. 3, 716 (March, 1957).

Quantum-mechanical calculation leads to the conclusion that CH_2 exists in a triplet ground state. The calculated H—C—H angle is 160^0. W.Good

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

5540. TRILINEAR CHART OF NUCLIDES. W.H.Sullivan.
Second edition. Washington: United States Atomic Energy Commission (Jan., 1957).

The systematics of, and physical constant data for, all experimentally identified nuclides, up to about July 1956, are recorded on a series of charts folded into book form, but capable of being joined into a continuous strip 11½ inches high for wall mounting. The information for the nuclides is printed in hexagonal frames, which are arranged on a triangular grid, giving simultaneous plots, with equal emphasis, of atomic mass (A) v. atomic number (Z), number of neutrons (A – Z) v. Z, and A – Z v. A. The three 120^0 axes thus represent, respectively, isotopes, isobars and isotones (same number of neutrons). Isodiapheres (same excess number of neutrons, A – 2Z) lie on a horizontal line. These are four pages of introduction explaining the symbols and the nature of the information available on the chart.

539.152.1

5541. SOLUTION OF THE NUCLEAR MANY-BODY PROBLEM. K.A.Brueckner and J.L.Gammel.
Phys. Rev., Vol. 105, No. 5, 1679-81 (March 1, 1957).

The energy E per particle in an infinite sea of nuclear matter, as a function of the average radius r_0 of the volume per particle, is obtained by numerical solution of the equations of the theory developed by Brueckner and his collaborators (e.g., Abstr. 3957/1955 and 8923/1956). The Gammel—Christian—Thaler potential is used, except that the contributions of odd states are omitted. The Coulomb repulsion, and linked cluster corrections, are neglected, and the angular momentum dependence and exclusion effect treated by an averaging process. The sensitivity of the result to the quantity δE, the distance off the energy shell at which the reaction matrices are evaluated, is studied and found to be small: a minimum E of -15.8 MeV results if $\delta E = 0$, and -14.5 MeV is δE is the difference between Fermi energy and ground state. Both of these minima occur at $r_0 = 0.98 \times 10^{-13}$ cm. Estimates of the effect of Coulomb repulsion increase this to 1.07×10^{-13} cm and cluster and energy denominator corrections lead to a final result of -14.8 ± 0.6 MeV, to be compared with the experimental values of 1.10×10^{-13} cm and -15.5 MeV, respectively. J.W.G.Wignall

539.152.1

5542. VELOCITY-DEPENDENT FORCES AND NUCLEAR STRUCTURE. I. CENTRAL FORCES. M.Moshinsky.
Phys. Rev., Vol. 106, No. 1, 117-23 (April 1, 1957).

Starting with the assumption that the forces between nucleons inside nuclear matter are the same as between free nucleons, a procedure is outlined by which information on the velocity dependence, and other features, in the two-nucleon interaction may be obtained from the level ordering in nuclear shell theory. In this paper it is restricted to the simplest type of velocity-dependent central force, which turns out to be similar to the reduced-mass type of force introduced for the motion in nuclear matter by Brueckner and by Johnson and Teller. If this force is taken with a sign such that the reduced mass is smaller than the mass of the nucleon, it behaves in the long-range approximation as a repulsive Majorana force. In the short-range approximation, the level ordering for the two-particle configuration goes in order of increasing J in the $p_{3/2}$ shell, in the order J = 4, 0, 2 in the $d_{5/2}$ shell, and in order of decreasing J in all other shells. For a three-particle configuration the ordering goes as J = 9/2, 5/2, 3/2 in the $d_{5/2}$ shell and as J = 9/2, 3/2, 5/2 in the $f_{5/2}$ shell. This ordering is compared with the experimental one, and restrictions obtained on the strength and range of the velocity-dependent force that may be added to the ordinary one. A.

539.152.1 : 539.162

REVIEW OF NUCLEAR SYSTEMATICS AND THEORIES. See Abstr. 4657

539.152.

5543. SHELL MODEL FOR THE POSITIVE-PARITY STATES OF N^{15}. E.C.Halbert and J.B.French.
Phys. Rev., Vol. 105, No. 5, 1563-9 (March 1, 1957).

Energy levels and wave-functions arising from the configuratio $s^4p^{10}s$, $s^4p^{10}d$, and s^3p^{12} have been calculated using a central plus single-particle spin–orbit interaction. Correlations have been mad between theory and experiment for a dozen identified positive parity levels in N^{15} (including the 5.31 MeV level). For the seven levels below 9 MeV this has been done mainly by considering N^{14}(d,p) l-values and reduced widths. In order of increasing energy, the the retical spin assignments for these levels are 5/2, 1/2, 7/2, 3/2, 5/ 1/2, 3/2 (the third and fifth could be interchanged); the wave-functions derived for these levels give fair agreement for level position and surprisingly good agreement for reduced widths. For the uppe levels correlations are made by means of the experimental spin assignments. The general agreement here is poor; in particular, a state which has been invoked to explain thermal-neutron capture an other neutron processes is not predicted, and the C^{15} β-decay lifetir is not properly given. In general, the wave-functions indicate a small interaction between configurations but, apart from this, are consistent with the idea that the inequivalent particle is effectively coupled to only one state for A = 14. A

539.152.

5544. SELF-CONSISTENT TREATMENT OF THE INDEPENDEN PARTICLE CENTRAL-FIELD NUCLEAR MODEL. G.E.Tauber an T.-Y.Wu.
Phys. Rev., Vol. 105, No. 6, 1772-83 (March 15, 1957).

The purpose of the present work is, starting from a given assumed nucleon-nucleon interaction $V(r_i - r_j)$ and the independent-particle, central-field approximation, to deduce all the consequence of this model by means of the Hartree—Fock—Slater theory. The $V(r_i - r_j)$ is chosen to satisfy the saturation requirement and to be co sistent with some of the properties of the two-nucleon system, but contains the strength factor V_0 as an undetermined parameter. Thi V_0 and the single-particle wave functions $\psi_n(r_i)$ are determined by the variational principle together with the requirement that the tota binding energy of the nucleus be equal to its empirical value. The binding energies of the individual nucleons in the various shells ar themselves approximately given by the Fock equations which also l to a central field which is different for the different shells. The average central field implied in the usual treatment of the shell mo is, however, the same for a nucleon in any shell, and this must be identified with some approximate average field obtained by a proce dure such as that suggested by Slater for an electron in an atom or in a metal. On the other hand, the central field in the sense of Har tree (i.e., obtained from the Fock theory by neglecting the exchang

terms) would be a very poor approximation as the exchange terms are not negligible compared with the direct terms. It is emphasized in the present work that the application of the variational principle to the problem rids the shell model of the inconsistent procedure in the usual treatments in which two independent assumptions concerning $V(r_i - r_j)$ and the average central field $V(r)$ are made. A comparison of the result of the present programme with the empirical facts will form a correct basis on which to judge the fairness or failure of the central-field approximation in the shell model. Numerical calculations have been carried out for the O^{16}, O^{15}, and O^{17} nuclei to illustrate the ideas of the self-consistent treatment of the independent-particle, central-field nuclear model. In a first approximation, the V_0 and the wave functions $\psi_n(r_i)$ are determined by the modified Ritz method. The binding energies and the effective "central fields" for the individual nucleons in the various shells are then calculated from the Fock equations by means of these $\psi_n(r_i)$. It is found that the parameter V_0 in O^{16}, O^{17}, and O^{15} comes out to be very nearly the same, that the Fock central potentials are considerably lower than the Hartree potentials; that the former exhibit a general shape of a wine-bottle with a diffuse boundary; and that the "binding energy of the last nucleon" does not come out very well from the Fock equations. A.

539.152.1

5545. NUCLEON MOTION IN A ROTATING POTENTIAL. J.G.Valatin.
Proc. Roy. Soc. A, Vol. 238, 132-41 (Dec. 4, 1956).

The problem of nucleons moving independently in a rotating oscillator potential can be solved exactly by elementary methods. The resulting simple expressions for the energy and moment of inertia are valid for all angular velocities, and will be of use in estimating corrections to the finer details of the rotational spectra of nuclei. The motion is analysed in terms of the orbits of the individual nucleons. The rotation of the average field induces particle motions with positive and negative orbital angular momenta, which are large in comparison with the angular momenta associated with the rotation of the orbits with the average angular velocity. The "rigid" value of the moment of inertia of the independent particle motion near an equilibrium deformation results from the cancellation of these much larger orbital contributions. The orbits "outside" closed shells contribute to the moment of inertia a value practically equal to that of a rigid body with the mass distribution of the whole nucleus. On account of cancellations, the resultant contribution of the deformed, closed-shell core is only a small fraction of the total value. A.

539.152.1

5546. EFFECT OF A REPULSIVE CORE IN THE THEORY OF COMPLEX NUCLEI. H.A.Bethe and J.Goldstone.
Proc. Roy. Soc. A, Vol. 239, 551-67 (Jan. 29, 1957).

Using Brueckner's method for the treatment of complex nuclei, the effect of an infinite repulsive core in the interaction between nucleons is studied. The Pauli principle is taken into account from the beginning. A spatial wave-function for two nucleons is defined, and an integro-differential equation for this function is derived. Owing to the Pauli principle, the wave-function contains no outgoing spherical waves. A solution is given for the case when only a repulsive core potential acts. The effective-mass approximation is investigated for virtual states of very large momentum. A.

539.152.1

5547. THE EFFECT OF P-STATE AND HIGHER ANGULAR MOMENTUM HARD-CORE INTERACTION IN NUCLEAR BINDING. D.J.Thouless.
Proc. Roy. Soc. A, Vol. 239, 108-12 (Feb. 12, 1957).

Brueckner's method for the study of complex nuclei is used to examine the effect of a hardcore interaction between nucleons with non-zero relative angular momentum. The P-state interaction is found to have a considerable influence on binding, and is liable to reduce the calculated stable nuclear density. Higher angular momenta should have only a small influence. A.

539.152.1 : 539.172

5548. NUCLEAR SIZE FROM COSMIC-RAY INTERACTIONS. M.S.Sinha and N.C.Das.
Phys. Rev., Vol. 105, No. 5, 1587-90 (March 1, 1957).

The total path length of 3625 penetrating charged secondaries of average energy 4 BeV has been measured in three plate assemblies of Al, Cu, and Pb inside a big square cloud-chamber. The total number of nuclear interactions observed were divided into two groups, (i) nuclear disintegrations (high-energy transfers) and (ii) nuclear scatterings (elastic), and the total cross-section and the cross-section for nuclear disintegrations alone have been determined. It has been found that the equivalent square-well radii of Al, Cu, and Pb found from the latter cross-sections agree well with $1.19A^{1/3} \times 10^{-13}$ cm whereas the radii corresponding to the total cross-sections follow $1.34A^{1/3} \times 10^{-13}$ cm. The results thus indicate the same matter distribution in Al, Cu, and Pb nuclei as that determined from high-energy electron scattering, μ-mesonic X-ray data, and high-energy neutron absorption data. Moreover, each nucleus appears to be surrounded by an equivalent spherical shell of thickness $0.15A^{1/3} \times 10^{-13}$ cm which chiefly accounts for the elastic nuclear scatterings. The existence of this shell is presumably the effect of the finite range of nuclear forces. A.

539.152.1

5549. A MODEL OF NUCLEAR SHAPE OSCILLATIONS FOR γ-TRANSITIONS AND ELECTRON EXCITATION. L.J.Tassie.
Austral. J. Phys., Vol. 9, No. 4, 407-18 (Dec., 1956).

A model of nuclear shape oscillations is set up for an arbitrary nuclear charge distribution. For a uniform charge distribution the model reduces to the liquid drop model. The model is used to consider γ-transitions and electron excitation of nuclei. Explicit expressions are obtained for four charge distributions: (a) uniform, (b) Gaussian, (c) exponential, (d) uniform with Gaussian "edge". The theory predicts a relative angular distribution of electrons scattered by the 4.43 MeV level of C^{12} in agreement with the experimental results of Fregeau and Hofstadter (Abstr. 9832/1955), but gives a scattered intensity seven times too large. A.

539.152.1

5550. SOURCES OF ERROR IN EXPERIMENTS ON REORIENTATION EFFECT IN COULOMB EXCITATION. G.Breit, R.L.Gluckstern and J.E.Russell.
Phys. Rev., Vol. 105, No. 3, 1121-2 (Feb. 1, 1957).

See Abstr. 7623 (1956). The errors arise from atomic hyperfine structure and affect the quantitative interpretation of data regarding nuclear excited states, particularly those obtained from heavy-ion scattering experiments. E.J.Burge

539.152.1 : 539.172.4

5551. EXCITATION OF NUCLEAR VIBRATION LEVELS BY FAST-NEUTRON SCATTERING. E.V.Inopin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 901-2 (1956). In Russian.

Formulae are developed for the angular distributions of scattered neutrons in the case of closed-shell nuclei and nuclei having closed-shell ±1 or 2 nucleons. The results are discussed in terms of the theory of A.Bohr (Abstr. 4524/1952). J.W.Gardner

539.152.1

5552. THE LEVEL SCHEME OF Cs^{131}. H.Vartapetian.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1512-14 (Nov. 12, 1956). In French.

γ- and γ-γ-coincidence spectra were obtained using NaI(Tl) scintillation counters; a level scheme is given. The K-conversion coefficient of the 122 keV γ-ray was measured as $\alpha_K = 0.39 \pm 0.04$, consistent with a pure M1 transition. A.O.Stanesby

539.152.1 : 539.172.13

5553. ON THE SPIN AND PARITY OF THE FIRST EXCITED STATE OF ^{19}O. R.V.Popić.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1597-8 (Dec., 1956).

The Tobocman theory of stripping is applied to the reaction $O^{18}(d,p)O^{19}$. The incident deuteron energy is 0.8 MeV, and the Coulomb effect must be allowed for. Comparison of theoretical and experimental distributions shows that the spin of the excited state is either $\frac{1}{2}^-$ or $\frac{3}{2}^-$. It is believed that the excitation level is too low to excite one of the outer nucleons up to the f-shell. It is more likely to cause a breakup of the O^{19} double closed shell which gives the spin $\frac{1}{2}^-$ for the 94 ∓ 8 MeV level of O^{19}. This implies an excitation of a p-nucleon of the O^{19} core to the nearest even shell. J.J.Phipps

539.152.1

5554. ISOTOPIC SPIN SELECTION RULES. IX. THE 9.58 MeV STATE OF ^{16}O. S.D.Bloom, B.J.Toppel and D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 2, 57-60 (Jan., 1957).

For Pt VIII see Abstr. 3545 (1957). The reaction $C^{12}(\alpha,\gamma)O^{16}$ through the 1– state of O^{16} at 9.58 MeV is detected and the radiative width measured as 6 MeV. This corresponds to $|M|^2 = 1 \times 10^{-5}$ in Weisskopf units or to a contamination of the predominantly T = 0 state with T = 1 or the ground state with T = 1 of $\alpha_0^2(1) \sim 3 \times 10^{-4}$. Alternatively if the transition is ascribed to a mixing-in by the Coulomb perturbation of the T = 1 state at 13.09 MeV we find H^C $H^C \sim 0.035$ MeV. A.

539.152.1

5555. ISOTOPIC SPIN SELECTION RULES. X. THE 7.18 MeV STATE OF ^{20}Ne. B.J.Toppel,S.D.Bloom and D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 2, 61-2 (Jan., 1957).

The possible E1 transition between the 3− state at 7.18 MeV and the 2^+ state at 1.63 MeV in Ne^{20} is forbidden by the isotopic spin rule. It has been sought using the reaction $O^{16}(\alpha,\gamma)Ne^{20}$ and it has been shown that the radiative width is less than 6 MeV. This corresponds to $|M|^2 \leq 4.3 \times 10^{-5}$ in Weisskopf units or to contaminations $\alpha_0^2(1) \leq 1.3 \times 10^{-3}$ of the 7.18 and 1.63 MeV states with T = 1 states. A.

539.152.1

5556. ISOTOPIC SPIN SELECTION RULES. XI. THE 8.06 AND 6.23 MeV STATES OF ^{14}N. D.H.Wilkinson and S.D.Bloom.
Phil. Mag. (Eighth Ser.), Vol. 2, 63-82 (Jan., 1957).

The decay scheme of the 8.06 MeV 1 − T = 1 level of N^{14} is reinvestigated using the reaction $C^{13}(p,\gamma)N^{14}$ at the 550 keV resonance. The relative strength of the isotopic spin forbidden transition to the first excited state is 0.022 corresponding to $\alpha_1^2(0)_{8.06} \sim 0.061$. Owing to the great strength to it of the transition from the 8.62 MeV 0+ state it seems that the 6.23 MeV T = 0 state must be 1−. The decay of this state has been determined; it has been reached by this E1 transition from the 1.16 MeV resonance. The strength of the isotopic spin forbidden transition to the ground relative to the allowed transition to the first excited state is 0.31 corresponding to $\alpha_0^2(1)_{6.23} \sim 0.078$. The closeness of these two isotopic spin impurities suggests that these two states may be each other's chief contaminators and in this sense the forbidden transitions from the one is the same radiation as the allowed transition from the other and vice versa. If this suggestion is correct $H^C \sim 0.45$ MeV which large value suggests some close relationship between the two states. In unravelling the decay schemes subsidiary pieces of information are obtained; in particular it seems that the 5.69 MeV state is very probably 1+. A.

539.152.1 : 539.172.13

5557. ISOTOPIC SPIN SELECTION RULES. XII. THE MIRROR REACTIONS ^{6}Li(d,n)^{7}Be AND ^{6}Li(d,p)^{7}Li. D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 2, 83-93 (Jan., 1957).

It is remarked that the mirror reactions $Li^6(d,n)Be^7$ and $Li^6(d,p)Li^7$ leading to the first excited states of the mirror nuclei form an excellent testing place for the prediction following the assumption of charge-independence that such mirror reactions have equal intrinsic probability. This is because the reactions are almost non-resonant which makes for the good operation of the isotopic spin rules and because the protons are emitted well above the Coulomb barrier which makes the interpretation of the experimental neutron to proton branching ratio rather simple. It is also remarked that the experiment may be performed without observing the neutrons and protons by using the gamma rays from the excited states to label the two transitions; all higher excited states are unstable to heavy particle emission and so do not yield gamma rays. The branching ratio is determined at 31 deuteron energies between 200 keV and 1.8 MeV. Over the whole range it agrees to within 15% with that expected from charge independence, but there are signs of a resonance-like maximum to the ratio at about 450 keV, which departure from the isotopic spin rule is in keeping with the behaviour of the Li^6 + d total cross-sections. A.

539.152.1

5558. THE INTERPRETATION OF THE LEVELS OF ^{19}F ON THE ROTATIONAL MODEL. E.B. Paul.
Phil. Mag. (Eighth Ser.), Vol. 2, 311-16 (March, 1957).

The rotational model is used to interpret the levels of the F^{19}. The even parity levels are interpreted as rotational bands on $K = \frac{1}{2}$ and $K = \frac{3}{2}$. K-admixture between bands is introduced and alters the level ordering. The wave-functions of Nilsson are used to derive other properties of the levels which are compared with experimental values and the shell model predictions of Elliot and Flowers (Abstr. 5585/1955). An interpretation of the odd partiy levels as members of a $K = \frac{1}{2}$ band resulting from a hole in the p-shell is suggested. L.L.Green

539.152.1

5559. ENERGY LEVELS IN F^{18} FROM THE $O^{17}(p,\alpha)N^{14}$ REACTION. K.Ahnlund.
Phys. Rev., Vol. 106, No. 1, 124-6 (April 1, 1957).

A separated isotopic target of O^{17} has been used to study the excitation function of ground state alpha-particles from the reaction $O^{17}(p,\alpha)N^{14}$ for proton energies between 1 and 3 MeV. Thirteen levels in F^{18} have been found, with excitation energies 6.666, 6.820, 7.304, 7.527, 7.552, 7.713, 7.728, 7.889, 7.917, 8.094, 8.216, 8.238, and 8.382 MeV. A.

539.152.1 : 539.163.2

ENERGY LEVELS IN W^{182}. See Abstr. 4665

539.152.1 : 539.163.2

NUCLEAR LEVELS IN THE MASS RANGE 195-199. See Abstr. 4666

539.152.1 : 539.172.13

ENERGY LEVELS OF F^{18} NUCLEUS. See Abstr. 4721

539.152.1

5560. A NOTE ON NUCLEAR ISOMERISM. P.Zieliński.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 9, 595-7 (1956).

An example is given of the calculation of the lifetime for an isomeric transition for $J = 0 \rightarrow 0$, yes, with a mechanism alternative to that given by Sachs, for weak coupling, applying Feynman's perturbation method. The meson field is PS(PS). The nuclear nucleon emits a virtual π^0-meson, decaying into two photons by proton–antiproton pair annihilation. The example is not a general solution as intermediate charged pion states are possible. The result indicates a very low probability for this isomer. J.J.Phipps

539.152.1

5561. M1 TRANSITION IN Tl^{208}. A.de-Shalit.
Phys. Rev., Vol. 105, No. 5, 1531-3 (March 1, 1957).

An attempt is made to explain the abnormally short lifetime of the 40 keV level in Tl^{208}. It is shown that although by assuming a certain configuration it is possible to arrive at a coherent contribution to the transition probability from the proton orbital momentum, its magnetic moment, and the neutron magnetic moment, this is not enough to explain the observed lifetime. Configuration interaction can be estimated fairly accurately in this case, and it, too, does not improve the agreement. A.

539.152.2

5562. ISOTOPIC SPIN IMPURITIES. F.C.Barker.
Phil. Mag. (Eighth Ser.), Vol. 2, 286-7 (Feb., 1957).

A table is given of matrix elements connecting T = 0 and T = 1 states of C^{12} in L–S coupling appropriate to the ground state of C^{12} and to a T = 0 state of about 20 MeV excitation. The large matrix elements of the Coulomb interaction are those coupling states belonging to different configurations. Those elements connecting states differing in the excitation of two particles are small compared with those for states differing in only one particle. Isomeric spin remains a useful quantum number up to high excitation energies. Large impurities are to be expected when two combining states are close together. The explanation of Wilkinson and Clegg (see Abstr. 5307/1956) for the large impurity in the B^{10} state is not tenable. J.J.Phipps

539.152.2

5563. NUCLEAR ALIGNMENT OF ^{147}Nd. G.R.Bishop, M.A.Grace, C.E.Johnson, H.R.Lemmer and J.Perez y Jorba.
Phil. Mag. (Eighth Ser.), Vol. 2, 534-40 (April, 1957).

Nd^{147} has been aligned in a crystal of neodymium ethyl sulphate. The directional distributions and states of polarization of the 90 and 530 keV γ-rays have been measured. It is concluded that both transitions are mixtures of M1 and E2 radiation (δ E2/M1 = −0.17 ± ± 0.15 for the 90 keV and +0.75 ± 0.25 for the 530 keV γ-rays) and that the 530 keV state has spin $7/2^+$. From the 530 keV results a value for the nuclear magnetic moment of Nd^{147} of 0.44 ± 0.06 nuclear magnetons is found. A.

539.152.2

5564. NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF K^{39}. G.W.Series.
Phys. Rev., Vol. 105, No. 3, 1128 (Feb. 1, 1957).

A complete analysis of the hyperfine structure of the $5\ ^2P_{3/2}$ state for K^{39} gives $Q = +(0.113 \pm 0.02) \times 10^{-24}$ cm^2. D.H.Whiffen

539.152.2 : 539.172.1

ANGULAR MOMENTUM AND PARITY OF O^{17} NUCLEUS. See Abstr. 4707

539.152.2 : 539.172.

THE EFFECT OF ISOTOPIC SPIN IMPURITY ON (γ,p) AND (γ,n) CROSS SECTIONS. See Abstr. 4728

539.152.2 : 523.5

INERT GAS ISOTOPE ABUNDANCE RATIOS IN METEORITES. See Abstr. 4990

539.152.2 : 541.5

5565. BONDING INFERENCES FROM NUCLEAR SPIN RESONANCE. J.E.Wertz.
J. phys. Chem., Vol. 61, No. 1, 51-5 (Jan., 1957).

Nuclei of non-zero spin take up discrete orientations in a magnetic field, and transitions between the spin energy levels occur as a resonant process with radiation in the radiofrequency region. Th

frequency of resonant absorption to a first approximation depends solely upon the nuclear species. More accurately, it may be modified by a number of effects. Besides resonant frequency, the absorption line amplitude and width may yield important information about the interactions of a nucleus with its atomic environment. Local magnetic fields due to other nuclei in a rigid solid may broaden or split a line. Paramagnetic ions may cause both a broadening and a shift. Shielding of the nucleus by outer electrons displaces a line and may give rise to a multiple-line spectrum if identical but chemically non-equivalent nuclei exist in the same molecule. The transmission of nuclear polarization effects through an electron-pair bond may lead to observable multiplicity. Rapid chemical exchange of non-equivalent nuclei leads to a single line intermediate between the positions of the separated lines. Solvent interactions — especially hydrogen bonding — may cause major shifts. Hydration of an ion may alter its resonance absorption line characteristics to a marked degree. When a nucleus possesses a quadrupole moment, the absorption line amplitude and width are very sensitive to electric field gradients arising from anisotropic interactions such as ion-pair or complex formation. Even sodium ion shows a marked sensitivity to its environment. Examples of such interactions are given for both inorganic and organic systems. A.

539.152.2 : 538.222 : 541.64

NUCLEAR MAGNETIC RESONANCE STUDY OF POLYMERS. See Abstr. 4848

539.152.2 : 541.127

CHEMICAL SHIFT IN NUCLEAR MAGNETIC RESONANCE PHENOMENON APPLIED TO STUDY THE KINETICS OF THE HYDROLYSIS OF ACETIC ANHYDRIDE. See Abstr. 4829

539.153

5566. PHOTOELECTRIC K AND L SHELL ABSORPTION COEFFICIENTS FOR HIGHLY IONIZED ATOMS. S.A.Moszkowski and R.E.Meyerott.
Astrophys. J., Vol. 124, No. 3, 537-41 (Nov., 1956).

The effect of electron screening on the photoelectric coefficients averaged over the K and L shells of ions has been computed from the work of Meyerott. The average absorption coefficient is less sensitive to screening effects. In some cases the average absorption coefficient can be expressed in terms of effective screening constants. A.

539.153

5567. THE TRANSITION PROBABILITY IN AN EXCITED ATOMIC SYSTEM WITH THREE UNEQUALLY SPACED ENERGY LEVELS. J.E.Blamont and J.M.Winter.
C.R. Acad. Sci. (Paris), Vol. 244, No. 3, 322-4 (Jan. 14, 1957). In French.

An exact solution by methods like those of Abstr. 7660 (1954) has been obtained, and confirmed in detail by measurements of the Stark effect in the $6\ ^3P_1$ level in Hg. J.Hawgood

539.153

5568. TRANSITION PROBABILITIES IN A HIGH FREQUENCY FIELD WITH VARIABLE AMPLITUDE. J.P.Barrat and J.M.Winter.
J. Phys. Radium, Vol. 17, No. 10, 833-41 (Oct., 1956). In French.

In h.f.s. studies of atomic beams where the atoms pass through a high frequency field H_1, it has been usual to assume that H_1 has a constant amplitude during a given time interval. Recent results (Abstr. 3116/1956) on line widths do not seem to agree with this assumption. These results can be explained from a mathematical treatment involving other distributions of the field (stepped and exponential). L.Bovey

539.153

5569. PRECISION METHOD FOR OBTAINING ABSOLUTE VALUES OF ATOMIC BINDING ENERGIES. C.Nordling, E.Sokolowski and K.Siegbahn.
Phys. Rev., Vol. 105, No. 5, 1676-7 (March 1, 1957).

Uses magnetic analysis of electrons expelled from an element by X-radiation. The total K binding energy of Cu was obtained to ±1 eV. New lines in the KLL and KLM Auger spectra from Cu were also observed. J.W.Sturgess

539.153

5570. CONTRIBUTION TO LAMB SHIFT DUE TO FINITE PROTON SIZE. W.Aron and A.J.Zuchelli.
Phys. Rev., Vol. 105, No. 5, 1681 (March 1, 1957).

The existing discrepancy between theoretical and experimental values for the Lamb shift in hydrogen is reduced when account is taken of the finite proton size. M.A.Grace

539.153 : 539.18 : 530.145

5571. SHIFT OF LEVELS OF μ-MESONIC HYDROGEN AND STRUCTURE OF THE PROTON. L.M.Afrikyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 908-9 (1956). In Russian.

Attention is drawn to the possibility of using the data on fine structure of energy levels of μ-mesonic hydrogen to obtain supplementary information about internal structure of the proton and the limits of applicability of quantum electrodynamics. Z.Krasucki

539.153.1

5572. RELATIONSHIP BETWEEN ATOMIC AND IONIC RADII. G.R.Somayajulu and S.R.Palit.
J. chem. Phys., Vol. 26, No. 4, 807-8 (April, 1957).

It has been found that the van der Waals volume (R_V^3) is directly proportional to the atomic surface area (R_C^2) for electronegative elements. The volumes of the negative ions have also been found to to similarly related to the square of their atomic radii, but the relation is restricted to the same group of the periodic table. The positive ion radii of the alkali and the alkaline earth metals have also been found to be linearly related to their metallic radii. A.

539.153.4

5573. MATRICES OF SPIN–ORBIT INTERACTION OF THE ELECTRON CONFIGURATION d^4 s. W.R.Bozman and R.E.Trees.
J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 95-100 (Feb., 1957).

The matrices of spin–orbit interaction of the d^4s configuration have been calculated. These matrices are for use in calculations to aid in locating levels and making electron configuration assignments in Tc I and Ta I. The calculations were made by using methods and tables given by G.Racah and by the use of tables of the W-coefficients prepared by L.C.Biedenharn, and by Obi and coworkers. The matrices have been checked by calculating their eigenvalues with the National Bureau of Standards Electronic Computer (SEAC). A.

539.153.4

5574. GROUND STATE OF THE HELIUM ATOM. T.Kinoshita.
Phys. Rev., Vol. 105, No. 5, 1490-502 (March 1, 1957).

The energy level of the ground state of atomic helium is restudied in detail. The nonrelativistic part is treated by the conventional Ritz variation technique. However, the trial functions used are more general than the ordinary Hylleraas-type functions since they contain negative power terms in addition to the positive power terms. Linear combinations of up to 39 terms are employed in the numerical computation. The best approximation for the ground state energy of the nonrelativistic Schrödinger equation obtained so far is -2.903 722 5 atomic units. The precision of the variation result is estimated by the evaluation of lower bounds to the ground state energy. The final result is about twelve times more accurate than the best published value. On the basis of these calculations, it is conjectured that the actual nonrelativistic energy will be lower than the best value by not more than 0.000 001 2 atomic unit. The accuracy of various approximate eigenfunctions is also estimated. It is thus found that the total contribution to this 39 parameter function from all the excited states will be of the order of 0.1%. Mass polarization and relativistic corrections are evaluated with various trial functions including the author's best ones. They seem to converge to certain limits with reasonable speed. It is therefore believed that the mass polarization and relativistic corrections to the ionization potential of the He ground state will be very close to -4.78 cm^{-1} and -0 57 cm^{-1}, respectively. With these corrections, and also the Lamb-shift correction for the ground state of the He atom (-1.23 cm^{-1}), the theoretical ionization potential becomes 198 310.38 cm^{-1} which is in a very good agreement with the best observed value 198 310.5 ± 1 cm^{-1}. A.

539.153.4 : 548.7

QUANTUM MECHANICS OF THE HYDROGEN ATOM. See Abstr. 4874

539.153.4 : 537.531

A RE-MEASUREMENT OF THE $L\alpha_{1,2}$ LINES OF LANTHANUM. See Abstr. 5368

539.155.2 : 537.363

5575. THE CONCENTRATION OF THE ISOTOPES OF LITHIUM BY ELECTROMIGRATION IN PAPER. A.Bonnin and M.Chemla.
C.R. Acad. Sci. (Paris), Vol. 243, No. 16, 1112-15 (Oct. 15, 1956). In French.

After electrophoresis of lithium ions in paper over a distance of 56 cm, the isotopic ratio Li^7/Li^6 varied from 7.6 at one end to 15.0 at the other (the natural ratio measured under the same conditions was 11.3). Curves are constructed showing the distribution of the two isotopes. The relative difference of mobility is deduced to be about 0.004. H.C.Cole

539.155.2

5576. ON A HEAVY WATER ELECTROLYSER FOR THE PRODUCTION OF DEUTERIUM FOR USE IN ACCELERATORS. A.Reznik, G.Laforgerie and G.Dupré.
C.R. Acad. Sci. (Paris), Vol. 244, No. 6, 760-2 (Feb. 4, 1957). In French.

The difficulties associated with the design of electrolysers for the above purpose are discussed. An improved design is described based on the principle that the resistance of the electrolyte varies as a function of the required yield. H.C.Cole

539.155.2

5577. BIBLIOGRAPHY ON NITROGEN 15. M.W.Chapman and H.P.Broida.
Circ. Nat. Bur. Stand., No. 575, 12 pp. (1956).

412 references to the literature on N^{15} that has appeared from 1919 to 1952, inclusive, with a few later references, are given on a selective basis. The citations relate to the abundance of N^{15} naturally occurring, its physical properties, methods of concentrating it, methods of N^{15}/N^{14} measurement, and the synthesis and uses of N^{15} compounds. A.

539.155.2

5578. CONCERNING THE SEPARATION OF ISOTOPES BY SURFACE DIFFUSION IN POROUS MEDIA. W.G.Trawick and A.S.Berman.
J. chem. Phys., Vol. 26, No. 3, 709-10 (March, 1957).

A partial separation of the isotopes of O_2, N_2 and A has been effected by allowing the gases to flow through a high surface area silica powder pack (diameter 1.75 cm, length 0.985 cm) under conditions where transport by a surface phase was a significant portion of the total flow. Measurements made at room temperature gave separation factors equal to those calculated on the basis of Knudsen flow, and comparable with those reported by Haul (Abstr. 11347/1954) but at 77°K lower values were obtained. A graph showing a typical set of results for O^{18}–O^{16} and O^{16}– O^{18} obtained at 77°K and 20 mm forepressure is given. H.C.Cole

539.155.2

5579. AN APPARATUS FOR CONTINUOUS ISOTOPIC ANALYSIS OF HYDROGEN–DEUTERIUM MIXTURES. M.Silvestri and N.Adorni.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1610-12 (Dec., 1956).

This is based on a thermal conductivity measurement. For a detailed account of the apparatus see earlier work (Abstr. 6858/1956). Hydrogen before exchange with deuterated water is used as a reference gas, and hydrogen after exchange as deuterated gas. A calibration up to 5% [D]/([D] + [H]) is given. The accuracy is quoted as better than 1×10^{-4} [D]/([D] + [H]) in the concentration range from zero to 3%. H.C.Cole

539.156 : 539.132

5580. AN EXACT CALCULATION OF SECOND ORDER LONG RANGE FORCES. A.Dalgarno and N.Lynn.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 223-5 (March, 1957).

The second-order interaction energy between a bare nucleus and an atom of different Z is calculated exactly and by power series approximations (see Abstr. 2336/1956). Also the exact energies of the $1s\sigma$ and $2p\sigma$ states of HeH^{2+} (Abstr. 3890/1956) are compared with the second-order perturbation result using the complete perturbing potential and that using its series expansion. J.Hawgood

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

5581. DETERMINATION OF ACTINIUM IN MINERALS. M.Perey and A.Hettler.
C.R. Acad. Sci. (Paris), Vol. 243, No. 20, 1520-2 (Nov. 12, 1956). In French.

AcX is used as intermediary by separation as sulphate with Ba present; the activity of the corresponding active deposit is measured by the method of Abstr. 7639 (1956). A.O.Stanesby

539.16.08 : 537.542

BETA-RAY CRYSTAL-SCINTILLATION COUNTING. See Abstr. 5413

539.16

5582. PROPERTIES OF FERMIUM-253. S.Amiel.
Phys. Rev., Vol. 105, No. 4, 1412-13 (Feb. 15, 1957).

A fermium sample was separated from a Cf^{252} target after α-bombardment, and its α-spectrum was measured. Peaks appear at 7.04 ± 0.02 MeV due to 30 hr Fm^{252}, 6.94 ± 0.04 MeV due to 4.5 ± 1.0 day Fm^{253}, and 6.64 ± 0.03 MeV due to E^{253}. The electron-capture–α-decay ratio of Fm^{253} is about 8.5. J.J.Wilkin

539.16

5583. RADIOACTIVITY OF Ti^{44}. J.R.Huizenga and J.Wing.
Phys. Rev., Vol. 106, No. 1, 90-2 (April 1, 1957).

Ti^{44} has been produced by the $Sc^{45}(d,3n)Ti^{44}$ reaction. The radiations of Ti^{44} were studied with gamma-scintillation spectrometers alone and in coincidence. A decay scheme is suggested in which Ti electron captures predominantly to a 144 keV level in Sc^{44} which in turn de-excites by two gamma-rays in cascade. A Ti^{44} half-life of approximately 10^3 years is deduced. A

539.163

5584. CONFIRMATION OF THE HALF-LIFE OF THORIUM-232. E.Picciotto and S.Wilgain.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1525-8 (Dec., 1956). In French.

This was deduced from measurements of the activity of RdTh in equilibrium with Th, counting the number of five-branched α-particle stars in nuclear emulsions. The half-life is (1.39 ± 0.03) x 10 years. A.O.Stanesb

539.163

5585. THE TOTAL ENERGY OF β-TRANSITION RaC–RaC'. A.V.Kogan and I.A.Sokolov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 904 (1956). In Russian.

Results of measurements of "delayed" β–γ and β–α coincidences indicate that β-transition with a limiting energy of 3.17 Me takes place not to an excited but to the ground level of RaC' nucleu Z.Krasuc

539.164.1 : 551.594

ALPHA-TRACKS IN NUCLEAR EMULSIONS EXPOSED TO AI WITH HIGH RADON CONTENT. See Abstr. 4918

539.164

5586. FINE STRUCTURE OF α-DECAY OF EVEN–EVEN NUCLEI. V.G.Nosov.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 3, 414-17 (1957). In Russian.

The probability of emission of an alpha-particle with the nucl remaining in a rotational state is obtained from the Schrödinger equation of the alpha-particle in a non-spherical field. This equat is solved in the semi-classical approximation and shows differenc from the adiabatic solution. G.E.Bro

539.164

5587. A SEMI-EMPIRICAL FORMULA FOR α-DISINTEGRATIC ENERGY IN THE REGION OF RARE-EARTH NUCLIDES. M.K.Rama Swamy.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1570-1 (Dec., 1956).

The α-disintegration energy is related to the number of protons (Z) and the number of neutrons (N) by the formula $E = 0.36Z - 1.19\,(N-82)^{1/2} - 17.89$. In the region considered the average error between calculated and observed values is ±5.2%. L.E.Muss

539.1

5588. THEORETICAL STUDY OF THE β-SPECTRUM OF RaE. R.Nataf.
J. Phys. Radium, Vol. 17, No. 6, 480-91 (June, 1956). In French.

With a suitable choice of parameters, the theoretical correct term, corresponding to the interaction $G_S S + G_t T(+G_p P)$ for a $1,- \rightarrow 0,+$ transition, gives a reasonable agreement with the exper mental spectrum of Plassman and Langer (Abstr. 2138/1955). A.O.Stanes

539.

5589. THE FLUORESCENCE YIELD FROM THE K-SHELL. SPECTROMETRIC MEASUREMENTS ON Tc_{43}^{99*} (6.04 HR) AND In_{49}^{115*} (4.5 HR). J Laberrigue-Frolow and P.Radvanyi.
J. Phys. Radium, Vol. 17, No. 11, 944-9 (Nov., 1956). In French.

Measurements with a magnetic β-spectrometer of K-Auger a K-conversion electrons are reported. The values $R_k = 0.70 \pm 0.0$ for T_c and $R_k = 0.87 \pm 0.03$ for In are deduced for the fluorescen yields. The relative intensities of the K-LL, K-LX and K-XY Au rays are respectively: 1 : 0.48 : 0.05 for T_c, and 1 : 0.42 : 0.05 for Using determinations of R_k for nuclei of Z = 18 to 92 published s 1946, a least-squares analysis gives the semi-theoretical curve $[R_k/(1 - R_k)]^{1/4} = -0.0217 + (0.0332)Z - (1.14 \times 10^{-6})\,Z^3$. J.J.Wilk

539.165

5590. THE L/K-CAPTURE RATIO OF GERMANIUM 71. R.W.P.Drever and A.Moljk.
Phil. Mag. (Eighth Ser.), Vol. 2, 427-36 (April, 1957).

A direct measurement of the L/K-capture ratio of Ge^{71} has been made using a special proportional counter system which avoids the effects of X-ray escape. One proportional counter is effectively enclosed by another, without any intermediate wall. With a gaseous source of germanium hydride and an argon filling at 6 atm, the ratio of the L- and K-peaks from the central counter, in anticoincidence with the surrounding counter, was determined. The L/K-capture ratio was found to be $0.128^{+0.005}_{-0.003}$. In addition, in a separate measurement, a value of 0.53 ± 0.03 was obtained for the K-fluorescence yield of gallium. A.

539.165

5591. ELECTRON-CAPTURE DECAY OF Am^{239} AND Am^{240}. W.G.Smith, W.M.Gibson and J.M.Hollander.
Phys. Rev., Vol. 105, No. 5, 1514-17 (March 1, 1957).

The conversion electron spectra arising from electron-capture decay of Am^{239} and Am^{240} have been studied with a 180^0 photographic spectrograph at ~0.1% resolution. The Am^{239} spectrum and the multipolarity data obtained therefrom are similar to those observed from the beta decay of Np^{239}, but the electron intensity data indicate somewhat different relative populations of the Pu^{239} excited states in the two cases. An attempt to assign the spin and parity of Am^{239} from ft values by the use of ΔI and ΔK selection rules does not give a consistent explanation. The energies of the first two excited states of Pu^{240} are accurately measured, and from these values (42.87 ± 0.04 and 141.77 ± 0.2 keV) the constants in the Bohr—Mottelson two-term rotational formula are evaluated: A = 7.16 ± 0.01 keV, B = 0.005 ± 0.002 keV. A.

539.165

5592. BETA DECAY AND ELECTRON CAPTURE BRANCHING TO THE LEVELS OF Pu^{239}. J.M.Hollander.
Phys. Rev., Vol. 105, No. 5, 1518-20 (March 1, 1957).

The experimental log ft values of the Np^{239} beta decay and Am^{239} electron capture are analysed according to the asymptotic selection rules proposed by Alaga for deformed nuclei. It is found that, with a reasonable choice of state assignments from the Nilsson energy-level diagram, a consistent interpretation can be given of the observed log ft values. All "allowed" transitions are retarded by at least an order of magnitude, whereas the "first forbidden" transitions observed here proceed with normal ft values. The interesting case of an "allowed" transition with log ft > 8 is discussed. A.

539.165

5593. EXPERIMENTAL TEST OF PARITY CONSERVATION IN BETA DECAY. C.S.Wu, E.Ambler, R.W.Hayward, D.D.Hoppes and R.P.Hudson.
Phys. Rev., Vol. 105, No. 4, 1413-15 (Feb. 15, 1957).

Co^{60} nuclei were aligned by a magnetic field in a low temperature cryostat. It was found that the nuclei emitted β-particles preferentially in the direction opposite to the nuclear spin. The association thus demonstrated between an ordinary vector (β-particle momentum) and an axial vector (nuclear spin) shows that parity is not conserved in β-decay. J.M.Cassels

539.165.2

5594. THE INTERACTION OF THE β-DISINTEGRATION IN THE CASE WHEN PARITY IS NOT CONSERVED. R.Nataf.
C.R. Acad. Sci. (Paris), Vol. 244, No. 7, 884-6 (Feb. 11); No. 8, 1031-3 (Feb. 18, 1957). In French.

The probability of emission for allowed transitions is calculated assuming that the Hamiltonian is not invariant with respect to inversion, though still invariant with respect to time reversal. The form of the spectrum, probabilities of capture, etc. are not modified. L.Pincherle

539.165.2

5595. THE INTERACTION OF THE β-DISINTEGRATION WHEN PARITY IS NOT CONSERVED. R.Nataf.
C.R. Acad. Sci. (Paris), Vol. 244, No. ?, 1187-90 (Feb. 25, 1957). In French.

See preceding abstract. The postulate of invariance with respect to time reversal is now abandoned, and invariance with respect to charge conjugation is thereby possible. The conditions obtained are discussed in connection with experimental results. The degree of longitudinal polarization of electrons and positrons is also calculated. L.Pincherle

539.165.2 : 539.152.2

5596. QUESTION OF PARITY CONSERVATION IN WEAK INTERACTIONS. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 104, No. 1, 254-8 (Oct. 1, 1956).

The question of parity conservation in β-decays and in hyperon and meson decays is examined. Possible experiments are suggested which might test parity conservation in these interactions. A.

539.165.2

5597. CONFIGURATIONAL MIXING IN β-DECAY THEORY. R.J.Blin-Stoyle and C.A.Caine.
Phys. Rev., Vol. 105, No. 6, 1810 (March 15, 1957).

It is shown that the deviations of log ft values from those predicted by the single-particle model in the β-decay of odd-A nuclei can be accounted for in terms of simple interconfigurational mixing. A.

539.165.2 : 539.166.2

5598. INTERNAL COMPTON EFFECT. É.G.Melikyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1088-90 (1956). In Russian.

Nuclear transitions accompanied by the simultaneous ejection of a K-electron and emission of a γ-photon have been designated "internal Compton effect" (Spruch and Goertzel, Abstr. 8614/1954). The present paper calculates, in Born approximation, relative transition probabilities for this effect when the virtual radiation field is 2^L-magnetic multipole and 2^{L+1}-electric multipole; illustrative examples are worked out. A general angular distribution formula is also given. J.W.Gardner

539.165.2

5599. INVESTIGATION OF CONVERSION LINES IN THE β-SPECTRUM OF A Eu^{152}—Eu^{154} MIXTURE. V.M.Kel'man, V.A.Romanov, R.Ya.Metskhvarishvili and V.A.Kolyunov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 39-47 (1957). In Russian.

Internal conversion lines in the K-shells and L- and M-subshells of S^{152m} and Gd^{154} were measured with a high-resolution prism β-spectrometer. The ratio of the conversion coefficients for 122 and 123.2 keV transitions were determined. The energy intervals between the conversion lines were measured with high precision. A.

539.166

5600. γ-γ ANGULAR CORRELATION IN THE REACTION $C^{13}(p,\gamma)N^{14}$. S.Gorodetzky, A.Gallmann, M.Croissiaux and R.Armbruster.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 62-5 (Jan 2, 1957). In French.

The cascade involving the N^{14} levels 8.62 MeV—6.23 MeV—0 MeV has been studied with a coincidence spectrometer. The experimental results reported suggest either $J = 1^+$ (almost pure M1 or E2 decay) or $J = 2^+$ (almost pure M1 decay) for the 6.23 MeV level. J.J.Wilkins

539.166.08 : 537.542

GAMMA-RADIATION MONITOR. See Abstr. 4947

539.166.2

5601. RADIATIONS FROM ^{66}Ge AND ^{67}Ge. R.A.Ricci and R.van Lieshout.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1592-3 (Dec., 1956).

Using scintillation counters and pulse analysers the γ-ray spectra were found for Ge^{66} and Ge^{67} produced by α-particle bombardment in a cyclotron. For Ge^{67} one strong γ-ray peak was found at 170 keV with a halflife of 21 min. For Ge^{66} peaks were found at 114, 70 and 45 keV all with a halflife about 2.5 hours. A peak at 186 keV with the same halflife was provisionally assigned to Ge^{66}. L.E.Mussell

539.166.2 : 539.172.13

PRODUCTION OF GAMMA-RAYS FROM BREMSSTRAHLUNG OF PROTONS. See Abstr. 4715

539.166.2 : 539.18

γ—γ ANGULAR CORRELATION IN MESO-ATOMIC TRANSITIONS. See Abstr. 4764

539.166.835

5602. PARITY OF WAVE-FUNCTIONS OF PARA- AND ORTHO-STATES. I.S.Shapiro.
Dokl. Akad. Nauk SSSR, Vol. 95, No. 5, 975-7 (1954). In Russian.

A non-relativistic electron is described by a spinor, a positron by a pseudo-spinor. Having opposite parity an electron and positron may form para- or ortho-states (the $^1S_0$ or $^3S_1$ states of positronium). Using a previously introduced formulation (Abstr. 615/1953) for the conjugate spinors and pseudo-spinors the even wave-functions of positronium are constructed and their transformation properties demonstrated. J.W.Gardner

539.166.835

5603. ANGLE DISTRIBUTION BY PAIR PRODUCTION IN PHOTOGRAPHIC EMULSIONS. J.P.Roalsvig.
Phil. Mag. (Eighth Ser.), Vol. 2, 133-7 (Jan., 1957).

Ilford C-5 nuclear plates were exposed at a 30 MeV betatron then scanned for electron pairs, the energy of each pair being calculated by the multiple scattering method. Results for the frequency distribution of the angle ϕ_p between the photon direction and the direction of any one of the electron pairs are presented together with results giving an experimental relation $\bar{\phi}_p = \frac{1}{2}(m_0c^2/E)$ where $\bar{\phi}_p$ is the mean angle for electrons with energies in a small interval at E. This result shows that $\bar{\phi}_p$ is of the order predicted by Bethe. The frequency distribution of the angle Ψ_p between electron pairs has also been measured and the results obtained follow the form predicted by Groshev although they are in disagreement with previous work. Values of $\bar{\Psi}_p$ are plotted as a function of the pair energy in intervals of 5 MeV and agree with previous experimental results in the medium energy range. The results are compared with the theoretical predictions of Borsellins. D.R.Chick

539.166.835

5604. ANNIHILATION OF POSITRONS IN LIQUID HELIUM. D.A.L.Paul and R.L.Graham.
Phys. Rev., Vol. 106, No. 1, 16-18 (April 1, 1957).

It has been shown experimentally that positron annihilation in liquid helium exhibits three components of lifetime. At 4.2°K and one atmosphere pressure the longest lived component has a mean life of $(9.1 \pm 0.5) \times 10^{-8}$ sec, an intensity ~ 13%, and has been shown experimentally to arise from $1\,^3S_1$ positronium. The predominant intermediate component has a mean life of $(1.83 \pm 0.15) \times 10^{-9}$ sec at the same temperature and pressure and displays approximately the same fraction of three-quantum annihilations which one expects from free positron annihilation. The shortest component ($\sim 2 \times 10^{-10}$ sec) is weak and is partially masked experimentally by annihilation in source materials. It would appear to arise from $1\,^1S_0$ positronium. A.

539.166.835

5605. ANNIHILATION OF POSITRONS IN LIQUID HELIUM. J.Wackerle and R.Stump.
Phys. Rev., Vol. 106, No. 1, 18-20 (April 1, 1957).

The annihilation scheme of positrons in liquid helium at 4.2°K was studied. Three components in the decay were observed with mean lives: $\tau_1 < 5 \times 10^{-10}$ sec, $\tau_2 = (2.6 \pm 0.2) \times 10^{-9}$ sec and $\tau_3 = (1.2 \pm 0.2) \times 10^{-7}$ sec. The abundance of the τ_3 component is (16 ± 2)% of all positrons which annihilate in the liquid. Three-quantum annihilation occurs in about 15% of all positron annihilations. This leads to the conclusion that the three components are due to parapositronium, free positron annihilation, and orthopositronium. A.

539.166.835

5606. POLARIZATION EFFECTS IN THE TWO-QUANTUM ANNIHILATION OF POSITRONS. L.A.Page.
Phys. Rev., Vol. 106, No. 3, 394-8 (May 1, 1957).

Computations of two-quantum annihilation-in-flight of a positron with an electron are made with little averaging of spins or summing of photon polarizations. For energies of a few MeV, strong departures are found from the better known situation at vanishing energy, as regards annihilation probability for parallel spins, the plane-polarization correlation, and the circular-polarization correlation. Production of a circularly polarized photon beam is discussed, as is longitudinal- or transverse-polarization analysis by a polarized electron target. A.

NUCLEAR REACTIONS 539.17

539.172

5607. DIRECT INTERACTION AND THE COMPOUND NUCLEUS FORMATION IN NUCLEAR REACTIONS. J.Dąbrowski.
Acta phys. Polon., Vol. 15, No. 4, 249-61 (1956).

The formulas for the reaction cross-section are derived taking into account both the compound nucleus and the direct interaction mechanisms. The derivation is based on Bethe's old treatment of nuclear reactions. The final formula for the direct interaction reaction amplitude is obtained in the Born approximation. The compound nucleus reaction amplitude is calculated for one level of the compound nucleus. The cross-section is built up with the compound nucleus, the direct interaction and the interference cross-sections. The formula is applied to the (n, d) reaction and the results compared with those obtained by Thomas. The treatment of this paper takes into account the transparency of the nucleus. A.

539.172

5608. DIRECT NUCLEAR REACTIONS. S.T.Butler.
Phys. Rev., Vol. 106, No. 2, 272-86 (April 15, 1957).

It is the contention of this paper that the large majority of nuclear reactions which proceed to a low-lying level of the final nucleus are predominantly direct reactions with stripping-like angular distributions. It is seen that reactions of the form (n,p), (p,p'), (α,α'), (α,p), etc. have essentially as much chance of proceeding directly as does the deuteron stripping or pickup reaction. This latter reaction no longer appears in a category of its own, but merely as one example of a whole gamut of types of reactions which proceed via a characteristic direct process. Differential cross-sections for the general class of direct reaction are calculated, and closed-form expressions obtained by means of the same approximations originally employed for the deuteron stripping reaction. It is seen that the angular distributions are dependent on the spins and parities of the initial and final nuclei involved, and are thus capable of yielding information regarding these properties; moreover the absolute magnitudes are capable of yielding interesting information concerning nuclear structure. Comparisons between theory and experiment are made for a few typical reactions. A.

539.172

5609. ENERGY DEPENDENCE OF CROSS SECTIONS NEAR THRESHOLD: NEUTRAL PARTICLES. W.H.Guier and R.W.Hart.
Phys. Rev., Vol. 106, No. 2, 296-9 (April 15, 1957).

A procedure is developed for determining the excess-energy dependence near threshold of reaction cross-sections involving the escape of an arbitrary number of neutral particles. It is somewhat analogous to Wigner's procedure (Abstr. 2572/1948) in that only an asymptotic solution of Schrödinger's equation is used, but is more readily applied to many-particle escape because it does not require the explicit matching of this solution at a reaction zone boundary. Explicit samples include the escape of two identical particles with arbitrary angular momentum, and the escape of an arbitrary number of identical particles with zero angular momentum. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172 : 539.152.1

NUCLEAR SIZE FROM COSMIC-RAY INTERACTIONS. See Abstr. 5548

539.172

5610. A PROBABLE EXAMPLE OF THE REACTION $K^+ + {}^{12}_6C \rightarrow K^+ + 3\,{}^4_2He$. F.Anderson, D.Keefe, A.Kernan and J.Losty.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1198-200 (Nov., 1956).

One event of this kind was found in 57 m of K^+-track in nuclear emulsion. J.M.Cassels

539.172

5611. INELASTIC SCATTERING OF 160 MeV π^--MESONS ON PHOTOGRAPHIC EMULSION NUCLEI. B.A.Nikol'skiĭ, L.P.Kudrin and S.A.Ali-Zade.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 48-58 (1957). In Russian.

The angular and energy spectra of π-mesons inelastically scattered on photographic emulsion nuclei have been obtained. The average energy of π-mesons scattered backwards ($\theta \geq 90^0$) was found to be 64.2 ± 3 MeV. Calculations of this scattering were made by the random test method on the assumption that the concept of individual meson–nucleon collisions in the nucleus is correct. The dependence of the obtained results on the accepted characteristics of the interaction between π-mesons and nuclei is considered in detail. The magnitude of the mean potential V of the π-meson nuclear interaction was determined by comparing the results of the calculations with the experimental data. For 160 MeV π^--mesons it was found to be $V = -(24 \pm 6)$ MeV. A.

539.172

5612. ELECTRODISINTEGRATION OF Cu^{63} AND Mn^{55}. R.L.Hines.
Phys. Rev., Vol. 105, No. 5, 1534-9 (March 1, 1957).

The electrodisintegration of Cu^{63} and Mn^{55} has been investigated for total electron energies from 29.5 MeV to 81.5 MeV by a stacked-foil experiment using the internal electron beam of a synchrotron. The value of $\bar{F}$, which is essentially the ratio of photon induced foil

activity to electron induced foil activity, is found to be 8.32 ± 0.54 at 29.5 MeV, 5.47 ± 0.36 at 46.5 MeV, 5.31 ± 0.25 at 63.5 MeV, and 4.97 ± 0.05 at 81.5 MeV for the $Cu^{63}(e,e'n)Cu^{62}$ reaction. For the $Mn^{55}(e,e'3n)Mn^{52*}$ reaction, which has an effective excitation energy of 42 MeV, F is found to be 6.67 ± 0.41 at 63.5 MeV and 7.43 ± 0.40 at 81.5 MeV. Upon comparing these values with the theoretical values of F for different multipole photon absorption processes, it appears that the resonance peak in the nuclear photon absorption cross-section for copper is due to a mixture of 97% of an electric dipole process and 3% of an electric quadrupole process. Nuclear size effects might make the experimental results compatible with a larger proportion of electric quadrupole process. Above the resonance peak, at energies near 42 MeV, the photon absorption appears to be due to either an electric dipole or a magnetic dipole process, but not an electric quadrupole process. A.

539.172.1

5613. $C^{13}(He^3,\alpha)C^{12}$ ANGULAR DISTRIBUTIONS AT 4.5 MeV. H.D.Holmgren, E.H.Geer, R.L.Johnston and E.A.Wolicki.
Phys. Rev., Vol. 106, No. 1, 102-4 (April 1, 1957).

The angular distributions of the α-particle groups from the $C^{13}(He^3,\alpha)C^{12}$ reaction which leave the C^{12} nuclei in the ground and first excited states have been measured at a bombarding energy of 4.5 MeV. The angular distributions have been fitted with Legendre polynomial expansions. In order to fit the data within the experimental uncertainties it was necessary to include polynomials up to the eighth degree in these expansions. It appears unlikely that the angular distributions can be accounted for on the basis of compound-nucleus type of reaction. Although the usual concept of a pickup type reaction also encounters difficulties in attempting to account for this reaction, theoretical calculations based on this type of process have been compared with the experimental results. Other possible mechanisms by which this reaction may take place are suggested. A.

539.172.1

5614. THE BOMBARDMENT OF OSMIUM BY NITROGEN IONS. G.W.Greenlees and L.G.Kuo.
Phil. Mag. (Eighth Ser.), Vol. 1, 973-5 (Oct., 1956).

Spongy osmium metal was bombarded by about 1 μA hr of N^{14} ions with energies about 10 MeV. The gamma-ray spectrum of the chemically-separated osmium activities was examined with a shielded NaI (Tl) scintillation counter. Osmium K X-rays were observed with three different half-lives, which were identified as due to isomeric transitions in stable isotopes of osmium. J.H.Fremlin

539.172.1

5615. NEUTRON-TRANSFER REACTIONS FROM THE NITROGEN BOMBARDMENT OF Be, C, O, Na, AND $Mg^{24,25,26}$. M.L.Halbert, T.H.Handley, J.J.Pinajian, W.H.Webb and A.Zucker.
Phys. Rev., Vol. 106, No. 2, 251-6 (April 15, 1957).

Excitation functions were measured for neutron transfer reactions yielding N^{13} from the nitrogen bombardment of Be, C, O, Na, Mg^{24}, Mg^{25}, and Mg^{26}. At the maximum incident energy of 27.5 MeV, the cross-section varies from 0.14 mb for oxygen to 2.8 mb for Mg^{25}. N^{13} was separated chemically from the targets and counted as ammonium tetraphenylboron. The chemical method was checked by measuring yields of both reaction products, N^{13} and Mg^{27}, in the reaction $Mg^{26}(N^{14},N^{13})Mg^{27}$. By plotting the transfer cross-sections as a function of $E^* = E_{c.m.} - E_{barrier} + Q$, a systematic behaviour of all the cross-sections is displayed. A.

539.172.11

5616. OPTICAL-MODEL ANALYSIS OF THE ELASTIC SCATTERING OF ALPHA PARTICLES. G.Igo and R.M.Thaler.
Phys. Rev., Vol. 106, No. 1, 126-33 (April 1, 1957).

The elastic scattering of 22 and 40 MeV alpha-particles on a variety of elements has been analysed in terms of an optical model. The nuclear optical-model potential assumed in this work has the form: $(V_R + iV_I)/\{1 + \exp[(r-r_1)/d]\}$. The diffuse character of the electrical charge distribution in nuclei was also taken into account. The four parameters in the nuclear optical model potential were varied so as to obtain the best fit to the data. The diffuseness parameter is found to be $d \cong 0.5 \times 10^{-13}$ cm and the parameter r_1, which represents an "average" radius of the nucleus–alpha-particle system, is found to be $r_1 \cong (1.35A^{1/3} + 1.3) \times 10^{-13}$ cm. The average values of V_R and V_I are −45 MeV and −10 MeV, respectively, at 40 MeV. Exceptions to this are the lightest elements, C, Al, and Ti, which require −30 MeV for V_R. At 22 MeV, V_R is found to be −31 MeV. Other parameters have the same values obtained at 40 MeV. A.

539.172.11 : 537.591.15

NUCLEON–PION CASCADES IN THE ATMOSPHERE PRODUCED BY α-PARTICLES. See Abstr. 5443

539.172.13 : 539.172.1

5617. DISINTEGRATION OF THE ^{9}Be NUCLEUS IN COULOMB FIELD. J.Sawicki.
Acta phys. Polon., Vol. 15, No. 5, 358 (1956).

Erratum to Abstr. 9910 (1955).

539.172.13

5618. PROBLEM OF THE INTERACTION OF ANTIPROTONS WITH NUCLEI. P.É.Nemirovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 3, 411-13 (1957). In Russian.

Nuclei with diffuse edges are investigated, using semi-classical approximations to scattering theory. It is shown that the large ratio of antiproton interaction to proton interaction with nuclei can be easily reproduced because of the diffuse edge. G.E.Brown

539.172.13 : 539.172.4

5619. AN ANALYSIS OF THE REACTIONS INDUCED IN COMPLEX NUCLEI BY NUCLEONS WITH ENERGIES BETWEEN 10 AND 20 MeV. G.Brown and H.Muirhead.
Phil. Mag. (Eighth Ser.), Vol. 2, 473-90 (April, 1957).

Calculations have been made of the absolute values of the cross-sections for processes of the type $_ZN^A(n,p\gamma)_{Z-1}N^A$, $_ZN^A(n,pn)_{Z-1}N^{A-1}$, $_ZN^A(n,n')_ZN^A$ and $_ZN^A(p,p')_ZN^A$, which have been induced by nucleons with energies between 10 and 20 MeV. It has been assumed that the target nucleus may be represented as a Fermi gas of nucleons, and that the nuclear processes proceed by direct interactions between the incident particle and the target nucleons, followed by the de-excitation of the nucleus; the ejection of a particle can occur during either process. Comparisons between the calculated and experimental data for the total cross-sections, energy spectra and angular distributions of the emitted particles, indicate satisfactory overall agreement except for the process $_ZN^A(p,p')_ZN^A$. Empirical evidence is cited, which indicates differences in the level densities of the excited states of even-even, even-odd and odd-odd nuclei. A.

539.172.13 : 539.18

5620. Z DEPENDENCE OF POSITIVE PION PRODUCTION BY 340-MeV PROTONS. W.Imhof, H.T.Easterday and V.Perez-Mendez.
Phys. Rev., Vol. 105, No. 6, 1859-62 (March 15, 1957).

The relative yield of positive pions produced in various elements by the 340 MeV external beam of protons was measured using a counter telescope to identify the mesons. The target materials used were Li (normal), Be, B^{10}, B^{11}, C, Al, Cu, Ag, and Pb. Mesons from these elements with energies 36 ± 4 MeV and 63 ± 4 MeV were observed at an angle of 135° relative to the proton beam. The effect of the penetration of the protons into the heavier nuclei on the resultant yield of pions was observed and the result compared with Gasiorowicz's theory. In the lighter nuclei, the effects of the increasing momentum-density distribution from Li to C were noted and approximate 1/e values were obtained for assumed Gaussian momentum distributions. A.

539.172.13

5621. CAPTURE OF PROTONS IN K^{39}. J.de Veiga Simao and J.P.F.Sellschop.
Phys. Rev., Vol. 106, No. 1, 98-9 (April 1, 1957).

Evaporated natural potassium metal targets were bombarded with protons from a Cockcroft–Walton generator. The excitation function was studied from 0.5 to 1.15 MeV. The gamma-rays from a level found in calcium 40 at 9.29 MeV above the ground state were studied with single-crystal spectrometers and with a pair spectrometer. Gamma-rays of energy 9.29 ± 0.005 MeV, 5.93 ± 0.005 MeV, 5.55 ± 0.005 MeV, 3.73 ± 0.005 MeV, and 0.500 ± 0.005 MeV were found and suggest a decay scheme in agreement with the levels in C^{40} found by Braams by inelastic proton scattering. A.

539.172.13

5622. ELASTIC SCATTERING OF 40-MeV PROTONS BY He^4. M.K.Brussel and J.H.Williams.
Phys. Rev., Vol. 106, No. 2, 286-90 (April 15, 1957).

Monoenergetic 39.8 MeV protons from a linear accelerator were scattered by purified helium gas. The elastically-scattered protons were detected at forty-three angles between 4° and 135° and the results are presented in terms of the absolute differential scattering cross-section per unit solid angle in the centre-of-mass system of coordinates. Definite minima and maxima in the variation of cross-section with angle were observed. A.

539.172.13

5623. DISINTEGRATION OF SILVER AND BROMINE NUCLEI BY HIGH-ENERGY PROTONS. V.I.Ostroumov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 3-13 (1957). In Russian.

Stars produced in heavy nuclei of photographic emulsions by 130, 460 and 660 MeV protons were investigated. Initial excitation

energy of the nuclei which corresponds on the average to the appearance of a definite number of "black" rays in the star was determined. By comparison with a theoretical evaporation curve dependence of the average number of particles emitted per disintegration on the excitation energy of the nuclei was determined. It was found that an appreciable amount of the cascade particles are α-particles. The energy spectrum of protons emitted in such disintegrations was investigated. The shape of the spectrum differs somewhat from that predicted by the evaporation theory even for low energies of the emitted protons, this effect being more pronounced for disintegration events induced by 660 MeV protons; it increases with the excitation energy. An estimation of the fraction of "black" protons involved in this effect agrees with the results obtained by other methods. A.

539.172.13

5624. AN INVESTIGATION OF NEUTRON GROUPS FROM THE REACTION $^{10}B(d,n)^{11}C$ AT 7.0 MeV DEUTERON ENERGY. A.Graue and B.Trumpy.
Phil. Mag. (Eighth Ser.), Vol. 2, 138-40 (Jan., 1957).

Deuterons from an 8 MeV Van de Graaff generator were used to bombard a 200 $\mu g/cm^2$ B^{10} target on a tantalum backing. Neutrons from the target were detected in Ilford C2 plates 400 μ thick placed at 0^0, 20^0, 60^0 and 90^0 to the beam direction. The areas scanned were 11 cm from the target. Five neutron groups were observed corresponding to levels in C^{11} at 8.5, 9.0, 10.0, 10.5 and 10.85 MeV and the angular distribution of the neutrons corresponding to the 8.5 MeV C^{11} level measured. By comparing this angular distribution curve with stripping theory, the assignment l = 0 was made for the captured proton which leads to even parity and spin 5/2 or 7/2 for the 8.5 MeV level in C^{11}. D.R.Chick

539.172.13 : 539.152.1

5625. ANGULAR DISTRIBUTION AND CORRELATION STUDIES OF Be^9, B^{10}, AND Mg^{24} (d,p) REACTIONS. S.A.Cox and R.M.Williamson.
Phys. Rev., Vol. 105, No. 6, 1799-808 (March 15, 1957).

(d,p) angular distributions have been measured along with (p,γ) correlations in Be^9, B^{10}, and Mg^{24} in order to test the applicability of stripping correlation theory and assign tentative quantum numbers. Deuteron energies were 2.5 to 4 MeV. All correlations exhibited the predicted deuteron energy independence and approximate angular symmetry in the (d,p) plane at energies above 3.5 MeV. The Be^9 correlation was shown to be isotropic to $\pm$ 7% in the plane perpendicular to the axis of the recoil nucleus. The observation of a (d,p) stripping peak 2 or 3 times the minimum yield is not a sufficient criterion for the observation of a correlation which is independent of deuteron energy. All correlations were of the form $1 + A\cos^2\theta$ (gamma, recoil nucleus). The observed A's were −0.50, 0.00, +0.50, −0.40, for Be^{10*} (3.37 MeV), B^{11*} (4.46 MeV), B^{11*} (6.67 MeV), Mg^{25*} (3.40 MeV), respectively. All uncertainties in A's were $\pm$ 0.05. Spin 1/2 is ruled out for Mg^{25*} (3.40 MeV). The Be^9 anisotropy is within 15% of one extreme of theoretically possible anisotropies. The incoming channel spin mixing ratio found in Be^9 can be obtained by assuming pure L–S coupling and a $^3P_2$ Be^{10*} level. The spin 9/2 is unlikely for the B^{11*} (4.46 MeV) level, while the spin 3/2 is ruled out and 9/2 is unlikely for the B^{11*} (6.76 MeV) level. A.

539.172.13 : 539.152.1

STRIPPING THEORY APPLIED TO THE $O^{18}(d,p)O^{19}$ REACTION. See Abstr. 5553

539.172.13 : 539.152.1

THE MIRROR REACTIONS $^6Li(d,n)^7Be$ AND $^6Li(d,p)^7Li$. See Abstr. 5557

539.172.3

5626. ON A NEW METHOD OF CALCULATING THE CROSS-SECTIONS OF NUCLEAR REACTIONS PRODUCED BY BREMSSTRAHLUNG RADIATION. R.Basile.
C.R. Acad. Sci. (Paris), Vol. 243, No. 22, 1759-61 (Nov. 26, 1956). In French.

The method described is based on a simple empirical expression for the upper part of the bremsstrahlung spectrum, and leads to an explicit formula for the cross-section in terms of a measured excitation curve. J.J.Wilkins

539.172.3

5627. MEASUREMENT OF THE ELASTIC SCATTERING OF 2.62 MeV γ-RAYS IN LEAD, BISMUTH AND URANIUM. P.Eberhard, L.Goldzahl, E.Hara and E.Alexandre.
C.R. Acad Sci. (Paris), Vol. 243, No. 23, 1862-5 (Dec. 5, 1956). In French.

The results of scintillation spectrometer measurements of the scattering cross-sections for angles between 25^0 and 125^0 are presented graphically. J.J.Wilkins

539.172.3

5628. ON THE NUCLEAR ABSORPTION OF PHOTONS. C.Tzara.
J. Phys. Radium, Vol. 17, No. 12, 1001-4 (Dec., 1956). In French.

The absorption cross-section of C^{12} was measured in the region of the 22.8 MeV (γ,n) resonance, using carbon absorber and detector. The (γ,n) activation curve was also measured in the same region. Analysis of the absorption measurements indicates $\Gamma_n > 400$ keV for the resonance. It is shown that the sharp "break" observed in the (γ,n) activation curve is consistent with this large width, and does not require $\Gamma < 40$ keV as previously supposed. J.J.Wilkins

539.172.3

5629. INVESTIGATION OF THE (γ,p) REACTION ON ZINC. R.M.Osokina and B.S.Ratner.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 20-6 (1957). In Russian.

Measurements of the yield and the angular and energy distribution of photoprotons emitted from zinc have been carried out at various bremsstrahlung peak energies ranging from 19.8 to 30.7 MeV. The results are compared with the statistical theory of nuclear reactions and with the direct photoeffect model. The data obtained with zinc confirm the conclusions regarding the significance of the direct photoeffect and the influence of shells for nuclei with Z ~ 30. A.

539.172.3

5630. ANGULAR AND ENERGY DISTRIBUTION OF PHOTONEUTRONS FROM Bi. G.N.Zatsepina, L.E.Lazareva and A.N.Pospelov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 27-30 (1957). In Russian.

The angular and energy distribution of photoneutrons emitted from bismuth on irradiation with X-rays of peak energy $E_{max} = 18.9$ MeV was investigated by the nuclear emulsion technique. A large number of energetic neutrons which cannot be explained within the framework of the statistical theory was detected. A

539.172.3 : 539.152.1

5631. SOME SUM RULES FOR THE CROSS-SECTIONS OF ELECTRIC QUADRUPOLE TRANSITIONS IN THE NUCLEAR PHOTOEFFECT. Yu.K.Khokhlov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 124-9 (1957). In Russian.

Two parameters which characterize the cross-sections for quadrupole transitions in the nuclear photoeffect are estimated. Other (known) parameters which characterize the dipole transition cross-section are used for the purpose. The estimations indicate that in intermediate and heavy nuclei the "centre of gravity" of the quadrupole transition cross-section is situated at energies exceeding 10-20 MeV. A

539.172.3 : 539.1

DISPERSION RELATIONS FOR THE PHOTOPRODUCTION OF PIONS. See Abstr. 4783

539.172.3 : 539.1

PHOTOPRODUCTION OF SLOW π-MESONS IN COMPLEX NUCLEI. See Abstr. 4784

539.172.3 : 539.1

PHOTOPRODUCTION OF π^0-MESONS. See Abstr. 4785

539.172.3 : 539.

Z DEPENDENCE OF POSITIVE PHOTOPION PRODUCTION. See Abstr. 4787

539.172

5632. THE ELASTIC SCATTERING OF 90 MeV NEUTRONS BY COPPER. G.Z.Shah and K.M.Gatha.
Curr. Sci., Vol. 25, No. 4, 113-14 (April, 1956).

The elastic scattering data of Bratenahl et al. (Abstr. 5309/19 are shown to be in accord with optical-model predictions using a complex potential derived from the scattering of 340 MeV protons M.A.Gra

539.17

5633. RESONANCE ABSORPTION OF NEUTRONS BY URANIUM CYLINDERS. M.V.Davis.
J. appl. Phys., Vol. 28, No. 2, 250-4 (Feb., 1957).

The integrated effective resonance neutron absorption cross-section of U^{238} cylinders has been experimentally investigated. T results of reactivity measurements were interpreted to yield the effective resonance integral as a function of the surface-to-mass ratio of the uranium cylinders. The experiments were extended t determine the Doppler coefficients resulting from heating the uranium in a constant neutron spectrum in the reactor. The effec

resonance integral, $\int(\sigma_{a_0})_{eff}dE'/E'$, can be approximated as a function of the surface-to-mass ratio by

$$\int(\sigma_{a_0})_{eff}d\frac{E'}{E'} = 6.0\left(1 + 15.6\frac{S}{M}\left[1-2.18\frac{S}{M} + 2.19\left(\frac{S}{M}\right)^2\right]\right).$$

The Doppler coefficient of resonance escape probability for the reactor is

$$(1/p)(\partial p/\partial T) = (-2.14 \pm 0.16)10^{-5}/\text{deg. C},$$

and the value assigned to the coefficient of the volume absorption of the resonance integral is

$$(1/A)(\partial A/\partial T) = (1.56 \pm 0.12)10^{-4}/\text{deg. C}.$$ A.

539.172.4

5634. LOW-ENERGY NEUTRON SCATTERING BY A SPHEROIDAL COMPLEX POTENTIAL. B.Margolis and E.S.Troubetzkoy.
Phys. Rev., Vol. 106, No. 1, 105-9 (April 1, 1957).

The scattering and absorption of low-energy neutrons ($kR \ll 1$) by complex square-well potentials of spheroidal shape $r = R(1+aP_2)$ is calculated by expanding the neutron wave-function in terms of appropriate spherical Bessel and Neumann functions times spherical harmonics. The convergence of the results obtained is demonstrated. The "strength function" $\overline{\Gamma}_n^0/D$, the average value of neutron width to spacing, is of particular interest in nuclear physics. It can be calculated from the scattering amplitude. This strength function is plotted as a function of atomic number in the region $A > 90$. The results are seen to deviate considerably from the corresponding results for spherical nuclei. Comparison is made with experiment. A.

539.172.4

5635. NEUTRON RESONANCES IN THE keV REGION: ODD-INTERMEDIATE NUCLEI. H.Marshak and H.W.Newson.
Phys. Rev., Vol. 106, No. 1, 110-16 (April 1, 1957).

The total neutron cross-sections of Sc^{45}, V^{51}, Mn^{55}, Co^{59}, Cu^{63}, and Cu^{65} have been measured in the energy range of ~ 1 to ~ 100 keV. The resonance parameters, including tentative J-value assignments, have been obtained for some of the more pronounced resonances observed. In the low-energy region, where the measurements overlap with those made with time-of-flight equipment, the results for the 2.36 keV resonance in Mn^{56} and the 4.1 keV resonance in Sc^{46} are in good agreement. $\overline{\Gamma}_n^0/\overline{D}$ (averaged between 1 and 100 keV) was determined for Cl, K, Ni^{58}, Ni^{60}, As^{75}, and the above six nuclei. To calculate $\overline{\Gamma}_n^0/\overline{D}$ the average experimental transmission data was compared to the average Breit–Wigner transmission. The variation of $\overline{\Gamma}_n^0/\overline{D}$ with atomic weight has been compared to the theoretical predictions of the Feshbach, Porter, and Weisskopf model of the nucleus. The results indicated that the peak is around A = 47, and the amplitude is about 5×10^{-4}. These values would roughly correspond to a real potential, $V_0 = 46.5$ MeV, and $\zeta = 0.05$ for the complex fraction of the potential; a square potential well and a radius $R = 1.45A^{1/3} \times 10^{-13}$ were assumed. A.

539.172.4

5636. $Al^{27}(n,\alpha)Na^{24}$ REACTION INDUCED BY 14.8 MeV NEUTRONS. I.Kumabe, E.Takekoshi, H.Ogata, Y.Tsuneoka and S.Oki.
Phys. Rev., Vol. 106, No. 1, 155-6 (April 1, 1957).

Samples of aluminium foil inserted between two C2 nuclear plates were bombarded with 14.8 MeV neutrons, and the angular and energy distributions of the alpha-particles resulting from $Al^{27}(n,\alpha)Na^{24}$ reaction were measured. It was found that the angular distribution of all energy regions in the centre-of-mass system is concave upward and approximately 90° symmetrical. Also the curve on a semilog plot of the relative level density calculated from the energy distribution of the alpha-particles fits a straight line which would correspond exactly to Maxwellian distribution with a temperature of about 1.45 MeV. The results are compared with the predictions of the statistical theory. A.

539.172.4 : 545.827

USE OF THE NEUTRON REACTIONS IN Si AND Al ANALYSES. See Abstr. 4851

539.172.4 : 539.152.1

EXCITATION OF NUCLEAR VIBRATION LEVELS BY FAST-NEUTRON SCATTERING. See Abstr. 5551

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

5637. RESULTS FROM AN ENRICHED NEGATIVE K-MESON BEAM. W.H.Barkas, W.F.Dudziak, P.C.Giles, H.H.Heckman, F.W.Inman, C.J.Mason, N.A.Nickols and F.M.Smith.
Phys. Rev., Vol. 105, No. 4, 1417 (Feb. 15, 1957).

Magnetically analysed K^--mesons of 435 MeV/c were degraded by 18.36 g/cm² polystyrene and bent through 180°, thus rejecting the pion background. Data on particle masses, interaction cross-sections, etc. are tabulated, obtained from measurements on 1224 K^--mesons recorded in an emulsion stack. J.J.Wilkins

539.18

5638. DOUBLE-PLATE CLOUD-CHAMBER STUDY OF V^0 PARTICLES: CLASSIFICATION AND RELATED RESULTS. I.C.Gupta, W.Y.Chang and A.L.Snyder.
Phys. Rev., Vol. 106, No. 1, 141-9 (April 1, 1957).

Two rectangular cloud-chambers have been used independently for the study of V^0 particles. A total of 39 347 pairs of good pictures was obtained, in which there were 3439 penetrating showers. 254 V^0 events have been found in these pictures, of which 129 are shower-associated events. 102 out of these show clear association with nuclear interactions having measurable origins in the first or second plate or in the chamber roof, and have been analysed according to the $\alpha-\epsilon$ projection procedure supplemented with the ionization values. From the measured angles of the two decay products relative to the V^0 particles, two alternative sets of ionizations of the decay products (for θ^0 and Λ^0 particles) have been obtained with the help of $\alpha-\epsilon$ diagrams and compared with the experimentally estimated ionizations. In this way 39 V events have been classified as due to θ^0 particles, 23 as due to Λ^0 particles, 11 as "nonclassified" events, and 13 as anomalous cases. After weighting the individual events for the detection efficiency, the numbers of θ^0 and Λ^0 particles are found to be 106 ± 31 and 52 ± 18, respectively. Distributions of the noncoplanarity angles show that both θ^0 and Λ^0 decays are most probably of the two-body type. The angular distribution of the decay products of θ^0 particles in the rest system indicates a spin higher than 0 for θ^0 particles. A.

539.18

5639. DOUBLE-PLATE CLOUD-CHAMBER STUDY OF V^0 PARTICLES: MEAN LIFETIMES OF θ^0 AND Λ^0 PARTICLES. A.L.Snyder, W.Y.Chang and I.C.Gupta.
Phys. Rev., Vol. 106, No. 1, 149-54 (April 1, 1957).

The mean decay-times of 35 θ^0 particles and 23 Λ^0 particles have been calculated according to the maximum-likelihood precedure as discussed by Bartlett. For each event, the decay length, the "total potential" decay length and the "plate-potential" decay lengths were measured with the usual caution. The velocity of each V^0 particle was determined from the $\alpha-\epsilon$ plots, and used to convert decay lengths into the corresponding decay times in the rest system. The mean decay-time for the 35 θ^0 particles is found to be $(0.8_{-0.2}^{+0.4}) \times 10^{-10}$ sec, and for the 23 Λ^0 particles $(2.8_{-0.7}^{+1.2}) \times 10^{-10}$ sec. The differential momentum distributions of the θ^0 and Λ^0 particles are obtained and appear to be different in shape and momentum range for the two types of V^0 particles. The mean detection probability of the chambers has also been studied as a function of the momentum of the V^0 particles. A.

539.18

5640. MESONIC DECAY IN FLIGHT OF A TRITON HYPER-FRAGMENT. F.Brisbout, M.W.Friedlander and P.Iredale.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 948-50 (Oct., 1956).

Total momentum balances obtained from ionization and scattering measurements and charge conservation have shown that a hypertriton produced in a 17 + 6p event in a photoplate decays in flight after 1.3×10^{-10} sec to give either

$$\left.\begin{array}{l} {}^3H_\Lambda \rightarrow p + p + \pi^- + n \\ \text{or } {}^3H_\Lambda \rightarrow p + d + \pi^- \end{array}\right\} \quad +34.4 \pm 1.4 \text{ MeV}$$

The track of the second decay product is too steep to allow an unambiguous identification. D.R.Chick

539.18

5641. REGENERATION OF θ_1^0 MESONS BY A MAGNETIC FIELD. M.L.Good.
Phys. Rev., Vol. 105, No. 3, 1120 (Feb. 1, 1957).

The suggestion of Gell-Mann and Pais (Abstr. 4088/1955) that θ_0 and its antiparticle $\bar{\theta}_0$ are different and transitions between them forbidden by conservation of a charge conjugation quantum number leads to the concept of two neutral K-mesons θ_1^0 and θ_2^0 with different decay modes. The author pursues this idea further by considering such particles which possess both spin and magnetic moment. Suppose that the θ_1-component decays fast after production leaving θ_2 which is a mixture of θ_0 and $\bar{\theta}_0$, but the latter has its magnetic moment reversed by virtue of charge conjugation. Therefore in a magnetic field the two component θ's have different energy and de Broglie wavelength, hence get out of phase. This means that the state is no longer a pure θ_2-state but has a component θ_1 which now decays fast. Thus the magnetic field regenerates θ_1 and the decay mode observed depends on the particle's history in magnetic fields. The idea is worked out quantitatively. H.Motz

539.18

5642. OBSERVATIONS OF THE FAILURE OF CONSERVATION OF PARITY AND CHARGE CONJUGATION IN MESON DECAYS: THE MAGNETIC MOMENT OF THE FREE MUON. R.L.Garwin, L.M.Lederman and M.Weinrich.
Phys. Rev., Vol. 105, No. 4, 1415-17 (Feb. 15, 1957).

It is shown that, in the $\pi-\mu-e$ decay sequence, the direction of emission of the electron is correlated with the direction of emission of the muon from which it comes. This association of an axial vector (the muon spin) with two separate ordinary vectors (the muon momentum in pion decay and the electron momentum in muon decay) shows that parity is conserved in neither reaction: The precession of the muon spin in an external magnetic field is demonstrated, and the muon gyromagnetic ratio is shown to be within 5% of the value expected for a Dirac particle of spin ½. J.M.Cassels

539.18

5643. NUCLEAR EMULSION EVIDENCE FOR PARITY NON-CONSERVATION IN THE DECAY CHAIN $\pi^+-\mu^+-e^+$. J.I.Friedman and V.L.Telegdi.
Phys. Rev., Vol. 105, No. 5, 1681-2 (March 1, 1957).

Preliminary data on 1300 decays in magnetically-shielded emulsions exposed to the Chicago synchrocyclotron are consistent with an angular distribution $W(\theta) = 1 - 0.12 \cos\theta$. The formation of "muonium" (μ^+e^-) may be an important cause of depolarization in such experiments. K.H.Barker

539.18

5644. PROBLEM OF THE SPIN OF THE Λ^0-PARTICLE. M.I.Shirokov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 734-6 (1956). In Russian.

General formulae relating the angular distribution of the decay products to the spin of the Λ^0-particle are given. G.E.Brown

539.18 : 530.145

DISPERSION RELATIONS FOR TAU-MESON DECAY. See Abstr. 5060

539.18

5645. MASS VALUE FOR THE Σ^- HYPERON. S.C.Freden and H.K.Ticho.
Phys. Rev., Vol. 105, No. 3, 1121 (Feb. 1, 1957).

An event in a nuclear emulsion has been interpreted as $K^- + p \rightarrow \Sigma^- + \pi^+$. The Σ^- was captured by an emulsion nucleus and produced a three-pronged star. If it is assumed that both the K^- and Σ^- came to rest before being captured, the range of the Σ^- allows an estimate to be made of its mass, giving $M_{(\Sigma^-)} = 2340.7 \pm 1.3\ m_e$, which agrees well with earlier estimates. E.J.Burge

539.18 : 537.591.1

MASS MEASUREMENTS OF SLOW COSMIC-RAY MESONS. See Abstr. 5442

539.18

5646. MAGNETIC MOMENT OF THE MU MESON. H.Suura and E.H.Wichmann.
Phys. Rev., Vol. 105, No. 6, 1930-1 (March 15, 1957).

Radiative corrections to the Dirac magnetic moment of the μ-meson are calculated. Besides correction terms similar to those calculated by Karplus and Kroll (Abstr. 3776/1950) for the electron anomalous moment there is a term due to virtual electron-positron pairs produced by virtual photons. The predicted magnetic moment is $[1 + (\alpha/2\pi) - 1.89(\alpha/\pi)^2](e\hbar/2m_\mu c)$. J.W.G.Wignall

539.18

5647. MAGNETIC MOMENT OF THE μ MESON. A.Petermann.
Phys. Rev., Vol. 105, No. 6, 1931 (March 15, 1957).

Calculation of the radiative corrections for the μ-meson magnetic moment by the same method as Suura and Wichmann (see preceding abstract); obtains the same result as these authors. J.W.G.Wignall

539.18

5648. DECAY OF τ'-MESON. V.V.Alpers and A.P.Mishakova.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 904-5 (1956). In Russian.

An event which was recorded in an emulsion chamber exposed to cosmic radiation is analysed. Z.Krasucki

539.18

5649. CHEW-THEORY APPROACH TO THE SCATTERING OF LOW-ENERGY K^+ PARTICLES BY NUCLEONS. H.P.Stapp.
Phys. Rev., Vol. 106, No. 1, 134-40 (April 1, 1957).

The method successfully used by Chew in the treatment of pion-nucleon scattering is applied to the scattering of K^+ mesons by nucleons. Two mechanisms are considered. In the first the K-mesons are emitted and absorbed directly by the nucleon or hyperon, and in the second the force is transmitted by the π-meson field in the manner proposed by Schwinger. Distinguishing characteristics of the two mechanisms are discussed and predictions concerning the angular distributions and isotopic spin dependence at energies less than 100 MeV are given. Some unusual features of the π-meson exchange mechanism connected with the S—P wave coupling are noted. Within the framework of the general Chew-type approach a predominant π-coupling mechanism appears incompatible with recent data. A direct emission absorption mechanism with γ_5 coupling and with the square of the $K-\Lambda$ nucleon coupling constant three times that of the $K-\Sigma$ nucleon coupling constant is suggested. The scattering obtained from this model using the Chew approach is considerably damped compared with the perturbation result. Correspondingly the coupling constant obtained from Chew theory is larger than that obtained from perturbation theory. A

539.18 : 537.591.1

A TRANSITION EFFECT OF π-MESONS PRODUCED BY THE NEUTRAL COMPONENT OF COSMIC RAYS IN LEAD. See Abstr. 5446

539.1

5650. THE PROBABLE IONIZATION DUE TO μ-MESONS IN A GAS, IN THE MOMENTUM RANGE $2 \times 10^8 - 1.2 \times 10^{11}$ eV/c. V.A.Lyubimov, G.P.Eliseev, V.K.Kosmachevskiĭ and A.V.Kovda.
Dokl. Akad. Nauk SSSR, Vol. 100, No. 5, 883-6 (1955). In Russian.

The momenta were measured, using a mass spectrograph, in the interval $0.46 \times 10^8 - 4 \times 10^{10}$ eV/c. A four-layer proportional counter (85 mm A, 350 mm C_3H_8) was employed to determine the ionization. This counter gave four independent measures of ionization for each ionizing particle, so that with a relatively small number of particles high accuracy was possible. The experimental results are in full agreement with the theories of Becker et al. (Abstr. 6601/1952), Kharitonov (Abstr. 3611/1954) and Eliseev et al. (Abstr. 2541/1954). The independence of the probable ionization of the momentum of the ionizing particle is verified for momenta $> 3 \times 10^{10}$ eV/c. S.Chome

539.1

5651. CATALYSIS OF NUCLEAR REACTIONS BY μ MESONS. L.W.Alvarez, H.Bradner, F.S.Crawford, Jr, J.A.Crawford, P.Falk-Variant, M.L.Good, J.D.Gow, A.H.Rosenfeld, F.Solmitz, M.L.Stevenson, H.K.Ticho and R.D.Tripp.
Phys. Rev., Vol. 105, No. 3, 1127-8 (Feb. 1, 1957).

Among about 2500 μ^- decays at rest observed in a liquid hydrogen bubble-chamber, 15 were associated with a 5.4 MeV μ^- meson starting within 1 mm of the end of the original μ^-. It is suggested that a $\mu-p$ mesic atom is first formed and becomes bound to a deuteron (1 in 5000 contamination) to produce a mesonic H—D molecular ion, with a consequent H—D spacing 1/200th of the normal. The time for the formation of He^3 is then small compared with the μ lifetime, and the reaction energy, calculated to be ~ 5.4 MeV, can be taken up by the μ^- meson. A search is being made for an unconverted γ-ray. Increased D contamination increases the fraction observed, but not in proportion. The reaction may be applicable to the suspected particle of mass 500 m_e. E.J.Burg

539.

5652. LABORATORY ENERGY DISTRIBUTION OF Λ^0 PARTICL G.T.Reynolds.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 933-4 (Oct., 1956).

Several interactions are pointed out which should be consider

in evaluating the possible anisotropy of Λ^0 production in complex nuclei on the basis of the laboratory energy distribution.

E.W.Kellermann

539.18

5653. ANGULAR CORRELATIONS BETWEEN DECAY PLANES OF τ^+-MESONS AND THEIR PRODUCTION GEOMETRY. T.Regge.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1615-17 (Dec., 1956).

Positive tau-meson production is considered according to the process $p + p \rightarrow p + \Lambda^0 + \tau^+$. Assuming nucleonic spin and parity for the Λ^0, the allowed transition matrices are evaluated for τ-spin $\pm1, \pm2$. It is concluded that if no correlation is observed there is no reason to believe the τ-spin to be zero. Spin 2 cannot be excluded unless production is near threshold. R.H.W.Johnston

539.18

5654. PRODUCTION OF π^+-MESONS BY 308 MeV π^--MESONS ON CARBON. V.V.Krivitskiĭ and A.A.Reut.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 2, 232-5 (1957). In Russian.

Positive mesons are detected in nuclear emulsions. For a π^+-energy of 40 MeV, a cross-section $(d^2\sigma/dE\,d\omega) = (2.6 \pm 1.3) \times 10^{-30}$ cm^2 sterad^{-1} MeV^{-1} is found. G.E.Brown

539.18 : 539.172.3

5655. ON THE ROLE OF COMPOUND STATES IN PHOTO-PRODUCTION PROCESSES. A.A.Logunov, B.M.Stepanov and A.N.Tavkhelidze.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 1, 45-7 (1957). In Russian.

In the photoproduction of mesons the system, target nucleus + "nascent" meson, may be regarded as a compound nucleus with its own characteristic states. The present paper shows how the dispersion relations of the photoproduction process may be formulated in terms of the anti-Hermitian compound state functions.

J.W.Gardner

539.18 : 539.172.3

5656. PHOTOPRODUCTION OF π^0 MESONS IN HYDROGEN. L.J.Koester,Jr and F.E.Mills.
Phys. Rev., Vol. 105, No. 6, 1900-13 (March 15, 1957).

This paper reports measurements of the total cross-section from 150 to 240 MeV of incident photon energy and measurements of the 135° differential cross-section from 180 to 215 MeV. A Monte Carlo evaluation of the γ-ray telescope efficiency by means of an electronic digital computer is outlined. The combined results indicate that a small but finite amount of S-state production occurs and that the angular distribution becomes flatter as the energy decreases. The latter effect is associated with production in unenhanced P-states and with a lack of electric quadrupole production. Good agreement with the Chew–Low theory is demonstrated by a comparison between the photoproduction and scattering of π^0-mesons, where the scattering cross-sections are derived from those for charged mesons by charge independence. A.

539.18 : 539.172.13

Z DEPENDENCE OF POSITIVE PION PRODUCTION. See Abstr. 5620

539.185

5657. ANGULAR AVERAGES IN THE SCATTERING OF SLOW NEUTRONS BY GASES. H.C.Volkin.
J. appl. Phys., Vol. 28, No. 2, 184-90 (Feb., 1957).

A procedure is developed for averaging over the thermal translational motion of a gas scatterer in order to obtain observed angular averages from a knowledge of the differential cross-section in the centre-of-mass system. The results are applied to the simple case of spherically symmetrical elastic scattering with constant cross-section. A.

539.185

5658. SLOW-NEUTRON SCATTERING BY MOLECULES. T.J.Krieger and M.S.Nelkin.
Phys. Rev., Vol. 106, No. 2, 290-5 (April 15, 1957).

The operator formalism in slow-neutron scattering theory introduced by Wick (Abstr. 7778/1954) and by Zemach and Glauber (Abstr. 3300/1956) is considered in an approximation in which molecular rotational and vibrational effects are explicitly separated. The combined effects of rotation and translation are treated in terms of the Sachs–Teller "mass-tensor" concept, which is rederived on the basis of a rigid molecule Hamiltonian and extended to include interference effects. Only elastic vibrational transistions from the ground vibrational state are considered. The applicable neutron energy range is restrictrd to values large compared to the rotational level separation but below the vibrational threshold. The method is applicable to the calculation of differential as well as total scattering cross-sections and to molecules of arbitrary structure. Expressions in closed form for these cross-sections are obtained through use of an approximate procedure for averaging over molecular orientations. In the case of hydrogenous molecules, where direct scattering is dominant, the scattering by a given nucleus is described in terms of two parameters, viz., an effective nuclear mass for rotation and translation, and a vibrational constant. The relative simplicity of the method is illustrated in the calculation of the differential and total cross-sections of CH_4 and the total cross-section of H_2. Agreement of these calculations with experiment and with other calculations is good. A.

539.185

5659. ANALYSIS OF POLARIZATION IN NEUTRON–PROTON SCATTERING. Y.Takano and M.H.Hull, Jr.
Phys. Rev., Vol. 106, No. 2, 321-6 (April 15, 1957).

An analysis of polarization in neutron–proton scattering experiments is described, and phase shifts of S and D waves for 310 MeV are presented. The calculation to obtain the S and D phase shifts has been arranged, assuming charge independence, to make use of experimental p–p polarization information in order not to depend on specific shift analyses of these data. The results indicate ranges of values of the phase shifts in which charge-independent fits to n–p and p–p data may be expected to exist. A.

539.185

5660. NEUTRON–PROTON SCATTERING AT 90 MeV. C.Y.Chih and W.M.Powell.
Phys. Rev., Vol. 106, No. 3, 539-44 (May 1, 1957).

An investigation of 90 MeV neutrons scattered by protons has been conducted with a cloud chamber filled with hydrogen or with a mixture of methane and hydrogen in a magnetic field of 22 000 gauss. The neutron energy spectrum has a full width at half maximum of about 30 MeV. The neutron scattering angles range from 8° to 180° in the centre-of-mass system. The differential scattering cross-section is found to have a symmetry about 90° in the centre-of-mass system. A.

539.185.08 : 541.15

5661. NEUTRON EXPERIMENTS WITH A SENSITIVE SZILARD-CHALMERS DETECTOR. R.D.Edge.
Austral. J. Phys., Vol. 9, No. 4, 429-35 (Dec., 1956).

The Szilard-Chalmers reaction has been developed as a sensitive detector for the comparison of neutrons from sources of different primary energy and angular distribution. Using sodium permanganate solution, a detection efficiency of approximately 7% for all neutrons in the energy range 0-5 MeV was obtained and high accuracy achieved. The method of detection was employed to make the following measurements: (i) The neutron yield from the spontaneous fission of natural uranium was found to be $(1.56 \pm 0.12) \times 10^{-2}$ neutrons sec^{-1} g^{-1}. (ii) The cross-section for the reaction $Li^6(\gamma,n)$ at 6.2 MeV was found to be $(3 \pm 2) \times 10^{-28}$ cm^2. (iii) The cross-section for the reaction $Be^9(n,2n)$ induced by Ra–Be and Po–Be sources of neutrons was found to be $(0.37 \pm 0.06) \times 10^{-24}$ cm^2. (iv) A limit was placed on the cross-over transition from the 2.5 MeV state to the ground state in Co^{60}. The transition probability was found to be less than 1×10^{-6} of that for the cascade consisting of the two γ-rays. A.

539.185.9 : 548.7

DENSITY CHANGES IN NEUTRON IRRADIATED QUARTZ. See Abstr. 4901

STRUCTURE OF SOLIDS 539.2

539.211

5662. CORNER FRACTURES IN EXPLOSIVELY LOADED THIN-WALLED STEEL CYLINDERS. S.Singh.
Brit. J. appl. Phys., Vol. 7, No. 12, 453-4 (Dec., 1956).

Conical surfaces of fracture (corner fracture) are often generated near the corner formed by the intersection of two free surfaces of an impulsively loaded body due to the highly localized stress concentration which develops when a transient compressional wave enters the corner. Tests were made with annealed steel cylinders each 6 in. long, 1 to 2 in. interval dia., and $\frac{1}{4}$ to $1\frac{1}{2}$ in. wall thickness, burst by detonating plastic explosive, and the base fragments from

which were collected in an ice box. All the fragments collected showed conical surfaces of fracture and it was concluded that the base of the tube broke into several fragments extending radially through the material and that the surface which was in contact with the detonating gas became more curved as the wall thickness of the tube decreased. The angle of fracture could not be accurately measured, but was between 45 and 52 degrees. A.C.Whiffin

539.215.08

5663. FLYING SPOT COUNTING AND SIZING OF NON-UNIFORM PARTICLES. H.W.Loeb.
Brit. J. appl. Phys., Vol. 7, No. 12, 440-1 (Dec., 1956).

A modified scanning principle involving a variable speed of scan is described which permits the extension of applicability of flying spot methods to particles, such as bubbles or droplets, characterized by a non-uniform degree of interception of the scanning beam. A.

539.217

5664. DIFFUSION OF NICKEL IN NICKEL OXIDE. M.T.Shim and W.J.Moore.
J. chem. Phys., Vol. 26, No. 4, 802-4 (April, 1957).

Diffusion coefficients for nickel in polycrystalline and monocrystalline nickel oxides have been measured by the surface activity method from 1000 at 1400°C in air. Within experimental uncertainty the values $D = 4.4 \times 10^{-4} \exp(-44.2/RT)$ fit both cases. These results indicate that the oxidation of nickel under comparable conditions of T and P proceeds via lattice diffusion of Ni through NiO. A.

539.217

5665. DIFFUSION AND EXCHANGE OF ZINC IN CRYSTALLINE ZINC OXIDE. E.A.Secco and W.J.Moore.
J. chem. Phys., Vol. 26, No. 4, 942-8 (April, 1957).

The exchange of zinc vapour with crystals of zinc oxide has been measured between 900 and 1025°. The ZnO crystals, incorporating radioactive Zn^{65}, were prepared by the reaction of zinc vapour and atmospheric oxygen. A sample of the crystals was weighed into a small quartz bucket suspended in a cylindrical quartz vessel. After addition of enough pure zinc to give the requisite vapour pressure, the vessel was evacuated and sealed. The ZnO sample contained about 1000 acicular crystals, with a mean diameter of 0.01 mm and a selected narrow distribution of diameters. At different times the bucket was withdrawn, and the residual radioactivity of the ZnO was determined. Except for the initial stages, the exchange reaction appeared to be controlled by the diffusion of Zn and ZnO. The diffusion coefficient D was calculated at 1 atm zinc pressure as $D = 4.8 \exp(-73.0 \text{ kcal/RT}) \text{ cm}^2 \text{ sec}^{-1}$. Variation of zinc pressure from 0.2 to 2.0 atm showed that D varies as $P_{Zn}^{0.65}$, suggesting that the diffusing species is the singly dissociated interstitial zinc ion, Zn_i^+. These results are consistent with observations on the rate of solution of zinc in zinc oxide, if $D = f_i D_i$ where f_i is the concentration of interstitial zinc and D_i is its mobility, but the possibility that the exchange rate is not diffusion controlled cannot be rigorously excluded. A.

539.217

5666. ANOMALOUS ISOTOPE EFFECT IN METALLIC DIFFUSION. D.Lazarus and B.Okkerse.
Phys. Rev., Vol. 105, No. 5, 1677-8 (March 1, 1957).

The diffusion of the radioactive isotopes Fe^{55} and Fe^{59} into pure monocrystalline silver has been determined at 883°C. The fractional difference in diffusion coefficient is about 15%. Classical theory predicts that the diffusion coefficient should be proportional to the square root of the mass of the diffusing atom; this would give a difference of about 4%, in disagreement with observation. A.B.Lidiard

539.217

5667. EFFECT OF HEAVY-DOPING ON THE SELF-DIFFUSION OF GERMANIUM. M.W.Valenta and C.Ramasastry.
Phys. Rev., Vol. 106, No. 1, 73-5 (April 1, 1957).

The germanium self-diffusion coefficients for intrinsic, heavily-doped n- and p-type germanium were measured at several temperatures. It was found that the self-diffusion coefficient is greater for heavily-doped n-type than for intrinsic germanium and that the self-diffusion coefficient for intrinsic germanium is greater than for heavily-doped p-type. If one assumes that a vacancy acts as an acceptor and that germanium self-diffusion goes by the vacancy mechanism, the observed changes in the value of the self-diffusion coefficient with doping are in the direction and of the order of magnitude of changes calculated from the shift in the Fermi level alone. It is concluded that germanium self-diffusion probably proceeds by the vacancy mechanism. A.

539.219

5668. SHORT-RANGE ORDER IN PARTIALLY ORDERED Cu_3Au. A.Paskin and R.J.Weiss.
J. appl. Phys., Vol. 28, No. 1, 140 (Jan., 1957).

It is pointed out that the probability of finding a copper atom as the nearest neighbour of a gold atom in partially ordered Cu_3Au, determined experimentally to be 0.96 by Chipman (Abstr. 7014/1956), is in good agreement with the theoretical value calculated by Peierls (1936), who based his theory on the Bethe cluster approach to order-disorder in alloys. J.Iball

539.219

5669. THE ELECTRONIC STRUCTURE OF PALLADIUM–URANIUM ALLOYS. J.A.Catterall.
Phil. Mag. (Eighth Ser.), Vol. 2, 491-8 (April, 1957).

The measured effects of uranium upon the paramagnetic susceptibility, electrical resistivity, thermoelectric power, and lattice parameter of palladium are discussed, and an interpretation of the results in terms of a solvent and solute band is suggested. A.

539.219

5670. PRECIPITATION OF Cu IN Ge. A.G.Tweet.
Phys. Rev., Vol. 106, No. 2, 221-4 (April 15, 1957).

The kinetics of precipitation of Cu from supersaturated solid solution in Ge have been studied as a function of temperature and dislocation density in the samples. The results can be expressed as an exponential decay with time of the unprecipitated fraction of Cu. For a given dislocation density the time constant for the precipitation is found to have a different temperature-dependence at high temperatures from its temperature-dependence at lower temperatures, and the temperature of the break in the curve is a function of dislocation density. It is proposed that the high-temperature precipitation is limited by the diffusion of Cu to dislocations by the dissociative mechanism described by Frank and Turnbull. At lower temperatures the rate-limiting step is believed to be the actual process of dissociation of a substitutional Cu into a vacancy and an interstitial Cu atom. The measurements permit an estimate of the vacancy concentration in Ge at ~ 715°C. A.

539.219

5671. SOLID SOLUTION IN THE GaAs–InAs SYSTEM. J.C.Woolley and B.A.Smith.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 153-4 (Jan., 1957).

X-ray evidence shows that this system forms a single phase at all compositions, but that this equilibrium state is not reached until the alloy has been annealed for about 300 hr at 900°C. See Abstr. 3756 (1957) for the system GaSb–InSb. A.R.Stokes

539.23 : 535.39

A THEORY OF MULTILAYER DIELECTRIC COATINGS. See Abstr. 5235

539.234

5672. A NOTE ON THE STRUCTURE OF EVAPORATED SILVER DEPOSITS PREPARED AT HIGH TEMPERATURES. F.H.Herbstein.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 251-3 (Feb., 1957).

Silver films deposited on a silica plate held at temperatures of 595°C or above showed preferred orientation with the (111) plane parallel to the substrate, irrespective of the angle of incidence of the molecular beam. Similarly, deposits formed at room temperature and vacuum-annealed at above 600°C aquired a preferred crystal orientation, (100) planes parallel to the substrate being dominant. K.W.Plessner

539.234 : 537.311.3

PREPARATION AND ELECTRICAL PROPERTIES OF THIN FILMS OF BISMUTH. See Abstr. 5322

539.2

5673. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON THE ELECTRON MICROSCOPY OF FIBRES — LEEDS, JANUARY 1956. C.E.Challice and J.Sikorski.
Brit. J. appl. Phys., Vol. 8, No. 1, 1-8 , 21-6 (Jan., 1957).

A conference on the electron microscopy of textile and other industrial fibres was held on 3 and 4 January, 1956, in the Department of Textile Industries, University of Leeds. The conference was organized by the Textile Physics Laboratory, under the auspices of The Institute of Physics. Seventeen of the eighteen papers are summarized. A

539.27

5674. INTERPRETATION OF HERRING-BONE [LAMES DE PARQUET] IMAGES OBTAINED IN THE ELECTRON MICROSCOPE WITH TABULAR CRYSTALS OF MOLYBDIC OXIDE. E.Pernoux.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2030-1 (Dec. 17, 1956). In French.

The appearance of the images is attributed to the slight misorientation of those parts of the crystal corresponding to the elements of the herring-bone pattern. This explanation is supported by the doubling of diffraction spots from the affected regions. J.Thewlis

539.27 : 537.533.2

5675. GRAIN BOUNDARIES FOR FIELD EMISSION MICROSCOPY. E.G.Brock.
J. appl. Phys., Vol. 28, No. 2, 241-4 (Feb., 1957).

Heretofore the observation of grain boundaries with the field emission microscope has been limited by the accidental and infrequent appearance of suitable specimens. A process for preparing polycrystalline tungsten samples by bending a tungsten wire, etching a tip at the bend and heating is described. Both large and small angle grain boundaries result. As many as five tungsten grains may share a cross-section of less than one micron in diameter. All the parameters required to describe the geometry of the boundaries may be obtained experimentally. Detailed observations on the dislocation structure of boundaries with angles as great as 6° are potentially possible. However, the field emission intensity from the region immediately adjoining and including the grain boundary must first be increased appreciably. Possible methods for achieving improved electron emission from the grain boundary region are discussed. A.

539.27

5676. CONVENIENT REPLICATION OF TEXTILE SURFACES FOR ELECTRON MICROSCOPY. W.R.McMillan.
J. appl. Phys., Vol. 28, No. 2, 277-8 (Feb., 1957).

Describes a rapid method for replicating the surfaces of a large number of textile fibres. A negative replica is prepared by pressing the fibres into warm polyethylene, extracting, dry-stripping a Parlodion positive replica from the polyethylene, shadowing with chromium at about 45°, shadowing with carbon perpendicularly, and lastly removing the Parlodion. An example is given. M.E.Haine

539.27

5677. EXPOSURE METER FOR THE ELECTRON MICROSCOPE. J.Moncassin.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 181A-182A (Nov., 1956). In French.

The current received by a metal disk inserted in the electron beam above the viewing screen is amplified and measured by a microammeter calibrated in exposure times. R.Reed

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.31

5678. DISLOCATION DAMPING AT HIGH TEMPERATURES. J.Weertman.
J. appl. Phys., Vol. 28, No. 2, 193-6 (Feb., 1957).

An unpinned dislocation damping model (based on the Mott–Nabarro solution hardening theory) was previously used to explain internal friction at room temperature and is now extended into the high-temperature range. With the model it is possible to explain the high-temperature internal friction which has been observed in the kilocycle frequency range for measurements made at very low strain amplitudes. In addition, the damping due to dislocation climb is considered. A.

539.31 : 535.55

5679. DEPENDENCE OF THE OPTICAL LIMIT OF ELASTICITY IN THE SYSTEM (111); [011] ON TEMPERATURE IN ROCK SALT CRYSTALS. A.V.Stepanov and V.P.Bobrikov.
Zh. tekh. Fiz., Vol. 26, No. 4, 795-99 (1956). In Russian.

539.32

5680. ELASTIC CONSTANTS OF STAUROLITE. J.Bhimasenachar and G.Venkata Rao.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 343-5 (March, 1957).

The elastic constants of Staurolite have been determined using the ultrasonic wedge method. The values of the constants are: $c_{11} = 34.3$; $c_{22} = 18.5$; $c_{33} = 14.7$; $c_{44} = 4.6$; $c_{55} = 7.0$; $c_{66} = 9.2$; $c_{23} = 12.8$; $c_{31} = 6.1$; $c_{12} = 6.7$ in units of 10^{11} dynes/cm^2. The value of compressibility is 7.58×10^{-13} cm^2/dyne. A.

539.32

5681. CARBON TANTALUM INTERNAL FRICTION PEAK. R.W.Powers and M.V.Doyle.
J. appl. Phys., Vol. 28, No. 2, 255-8 (Feb., 1957).

The internal friction peak in tantalum arising from the diffusion of interstitial carbon has been located at 338° C for vibration frequencies of 0.55 c/s. The corresponding activation energy is 39.6 kcal. The identification of this peak is made difficult by its proximity to the nitrogen peak. However, the two can be distinguished by the lesser stability of the carbon peak with respect to ageing at 400° C and by a different dependence of peak height on solute concentration. A.

539.32

5682. MEASUREMENT OF THE MODULUS OF RIGIDITY OF NICKEL UP TO 1000° C. C.Susse.
J. Phys. Radium, Vol. 17, No. 10, 910-11 (Oct., 1956). In French.

The rigidity of a Ni specimen of high purity, annealed for an hour at 850° C, was observed at different temperatures by a dynamic method in which vibrations were transmitted to the specimen in a furnace by means of fine Ni and Pt wires. The plot of rigidity against decreasing temperature is slightly different from that against increasing temperature, and shows a sharp drop as the temperature falls through 355° C. J.G.Oldroyd

539.373

5683. METALLOGRAPHY OF A MEDIUM CARBON STEEL SUBJECTED TO SLOW AND IMPACT COMPRESSION. J.D.Campbell, J.Duby and K.E.Puttick.
Phil. Mag. (Eighth Ser.), Vol. 2, 548-53 (April, 1957).

Specimens of medium carbon steel subjected to slow and dynamic compression have been examined by optical and electron microscopy. In slow deformation, coarse slip in ferrite occurs in very narrow regions on corrugated surfaces; this behaviour appears to be related to the presence of an ageing precipitate. Coarse slip is absent in rapidly strained steel; the metal deforms by fine slip which occasionally forms deformation bands. Deformation twins were only observed on one specimen of which the microstructure was abnormal. A.

539.374

5684. BOUNDS FOR THE COLLAPSE LOAD OF A BEAM COMPRESSED BY THREE DIES. W.Freiberger.
Austral. J. Phys., Vol. 9, No. 4, 419-24 (Dec., 1956).

This paper deals with the problem of the plastic deformation of a beam under the action of three perfectly rough rigid dies, two dies applied to one side, one die to the other side of the beam, and single die being situated between the two others. It is treated as a problem of plane plastic flow. Discontinuous stress and velocity fields are assumed and upper and lower bounds for the pressure sufficient to cause pronounced plastic yielding determined by limit analysis. The treatment is approximate and subject to experimental verification. A.

539.374

5685. THEORY OF PLASTIC DEFORMATION OF METALS. N.S.Akulov and P.P.Galenko.
Dokl. Akad. Nauk SSSR, Vol. 103, No. 3, 387-90 (1955). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 672 (1956).

On the assumption that a crystal is composed of equal-volume blocks which behave as units in plastic deformation, equations for the area of the hysteresis loop on a twist–torque diagram for plastic shearing are deduced, which are found to fit experimental results satisfactorily. R.C.Murray

539.374 : 578.088.2

PRELIMINARY MEASUREMENTS ON THE VISCOELASTIC PROPERTIES OF ANIMAL TISSUES AT AUDIO-FREQUENCIES.
See Abstr. 4921

539.375 : 539.23

5686. EQUIPMENT TO MEASURE THE ENERGY ABSORPTION OF FILMS AT HIGH STRAIN RATE. R.D.Spangler and E.B.Cooper.
J. appl. Phys., Vol. 28, No. 3, 329-33 (March, 1957).

The design and performance of equipment to measure film toughness under impact loading is described. The measured quantity is the amount of energy absorbed by a film when a ball is projected through it. The velocity of the ball can be varied from about 20 ft/sec to 800 ft/sec. A conditioning chamber permits testing over a temperature range of -40°C to $+80^{\circ}$C. Individual tests require a specimen of film of about $1\frac{1}{4}$ x $1\frac{1}{4}$ in. and can be made at the rate of about 2/min. Results are given for films of several commercial materials. A.

539.377

5687. CALCULATION OF ACTIVATION ENERGIES FROM CALORIMETRIC WORK CARRIED OUT AT A CONSTANT RATE OF HEATING. J.F.Nicholas.
Austral. J. Phys., Vol. 9, No. 4, 425-8 (Dec., 1956).

Some recovery processes in metals occur at temperatures too high to be readily accessible to isothermal calorimetric studies and such phenomena are more conveniently investigated using a constant rate of heating. It is shown that the activation energies of these processes (e.g. annealing) can be determined from calorimetric work carried out at a constant rate of heating. A.

539.4.011.25

5688. A POSSIBLE MECHANISM FOR THE FRACTURE OF METALS. F.E.Fujita.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1201 (Nov., 1956).

It is generally accepted that pre-existing large stress-concentrators, such as the Griffith crack, are inconceivable in pure metal crystals because their dimensions would be too large. Since the fracture of metals is usually accompanied by plastic flow, the mechanism of failure might be to produce a long flat void of length equal to the number of annihilated pairs of dislocations multiplied by the Burgers vector of each dislocation. Such a mechanism gives the required large stress concentrator in plastically deformed crystals; the eventual size of the void is unsatisfactory as a cause of fracture because it collapses after a little further increase in its length. However, if it may be assumed that when some excess dislocations of either sign are squeezed into the void due to concentrated stress exerted by the rear dislocations in one side, the cross-section of the void may be considered elliptical and the stresses around it computed. In this way, computations may be made of the number of excess dislocations contained in the void and liable to produce a crack. Full details are to be published elsewhere. A.C.Whiffin

539.4.016.2 : 548.7

5689. THE EXISTENCE OF MICROCRACKS AFTER COLD-WORK. A.N.Stroh.
Phil. Mag. (Eighth Ser.), Vol. 2, 1-4 (Jan., 1957).

It is suggested that changes in density and electrical resistance on cold-work may be due to the formation of microcracks. To fit the experimental values of Clarebrough et al. (Abstr. 10008/1956, 8436/1956) 8×10^4 cracks per cm^2 are needed, each 1.3×10^{-3} cm A. in length.

539.431

5690. METAL FATIGUE AT HIGH FREQUENCY. E.A.Neppiras.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 393-401 (April, 1957).

Metal specimens were subjected to tension–compression stresses above the fatigue limit at frequencies around 18 kc/s produced by a resonant magnetostriction transducer in an attempt to devise a test procedure lasting only a few hours compared with the days required by conventional low frequency techniques. The transducer was coupled to the specimen through a mechanical transmission line using resonant tapered elements to transform up the alternating stresses from the transducer to a value above the fatigue limit. The specimen was cut to be resonant at the required frequency and had a symmetrically-tapered section, the diameter at the centre, 3/16 in., being half that at the ends. The sample was hard soldered to the free end of the final transformer in the transmission line, and was bored along its axis to permit water cooling. The amplitude of vibration was measured microscopically to an accuracy of ± 80 microinches (about 2.3% of the amplitude corresponding to the fatigue limit), and the peak axial strain at any point along the specimen was taken as half the slope of the curve relating peak-to-peak amplitude to distance. No change occurred in the electrical impedance of the system until near failure. Number of cycles to failure below 2×10^6 could not be recorded with accuracy. The slope of the temperature-of-cooling-water–applied-stress curve provided an additional indication of the fatigue limit.

A.C.Whiffin

539.434

5691. STEADY-STATE CREEP THROUGH DISLOCATION CLIMB. J.Weertman.
J. appl. Phys., Vol. 28, No. 3, 362-4 (March, 1957).

A dislocation-climb creep model is considered which does not require the production of immobile dislocations. The creep equation that results from the analysis is

$$\text{creep rate} = A\sigma^3 \sinh(B\sigma^{1.5}/kT) \exp(-Q/kT),$$

where A and B are constants, σ is the stress, Q is the activation energy of creep and kT has its usual meaning. This equation is quite similar to one previously proposed. A

539.63

5692. A GENERAL THEORY OF THE SURFACE FRICTION OF SOLIDS. E.H.B.Williams.
Proc. Phys. Soc. B, Vol. 70, Pt 4, 431-2 (April, 1957).

It is demonstrated that in the general theory of surface friction of solids proposed by Rubenstein (Abstr. 2760/1957) it is unnecessary to assume a geometrically regular distribution of asperities all with the same radius of curvature. J.W.Menter

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM.

CHEMICAL REACTIONS 541.11/.12

541.124 : 548.73

5693. REACTION PRODUCTS OF γ PICOLINE AND IODINE. D.L.Glusker and A.Miller.
J. chem. Phys., Vol. 26, No. 2, 331-7 (Feb., 1957).

From the reaction products of γ picoline and iodine two distinct compounds have been isolated and studied by chemical, spectroscopic, and X-ray radial distribution methods. The second of these compounds to be isolated is an intermediate in the formation of the first, and is analogous to the addition compound of pyridine and iodine prepared by many workers. The X-ray radial distribution analysis of the first compound showed that the covalent bond in the iodine molecule had been broken, and the corresponding analysis of the second compound showed that the covalent bond was still present. A mechanism has been postulated for the reaction of the second compound with excess γ picoline to form the first compound. The applicability of the Geiger counter X-ray diffractometer to the radial distribution method is discussed, and the theory for the radial distribution analysis of diffraction data consisting of discrete peaks is presented. A

541.12

5694. ON THE THEORY OF OXIDATION–REDUCTION REACTIONS INVOLVING ELECTRON TRANSFER. II. APPLICATIONS TO DATA ON THE RATES OF ISOTOPIC EXCHANGE REACTIONS. R.A.Marcus.
J. chem. Phys., Vol. 26, No. 4, 867-71 (April, 1957).

The rates of some homogeneous isotopic exchange reactions in solution are considered in the light of the quantitative theory of redox processes developed in Pt I (Abstr. 5470/1956). The relative importance of several factors influencing the rates of these reactions is discussed. These factors include the Coulombic repulsion between the ionic reactants and the extent of solvation of the ions. Free energies and entropies of activation of various reactions are calculated from the theory without the use of any adjustable parameters. The agreement with the experimental data is considered to be satisfactory. On the basis of the theory and of earlier experiments in heavy water an experimental method is tentatively suggested for

distinguishing electron and atom transfer mechanisms. This method applies to halide-catalyzed exchange reactions of metal aquo-ions, and to other anion-catalyzed reations of this type not involving breakable OH bonds. A.

541.124

5695. ON THE THEORY OF OXIDATION–REDUCTION REACTIONS INVOLVING ELECTRON TRANSFER. III. APPLICATIONS TO DATA ON THE RATES OF ORGANIC REDOX REACTIONS. R.A.Marcus.
J. chem. Phys., Vol. 26, No. 4, 872-7 (April, 1957).

The theory (see preceding abstract) is used to calculate the rates of organic redox reactions whose mechanism involves the transfer of an electron from one reactant to the other. The theory can be used to discuss factors affecting the rates of these reactions. These factors include a standard free energy of reaction, the Coulombic interaction of the ionic charges of the reactants, and the solvation of the charged reactants. Attention is focused on the relation between the rate of the redox step in the over-all process and the standard free energy change, ΔF^0, of this step, rather than on the more usual but less fundamental one between the corresponding quantities of the over-all process itself. An approximate method is described for applying the theory to a molecule whose charge is not located at its centre. Essentially all organic molecules lie in this category. As an example of these considerations, several typical reactions are discussed. These reactions involve the oxidation of a series of hydroquinones by ferric ions and of a series of leucoindophenols by dissolved oxygen. They are assumed to possess electron transfer, rather than atom transfer, mechanisms. Free energies and entropies of activation of the redox step are calculated using the theoretical equation. The calculated results are considered to be in reasonable agreement with the experimental data, no adjustable parameters being employed. A.

541.124

5696. SELECTIVE SOLVATION AND DIELECTRIC SATURATION AS RELATED TO ELECTRON EXCHANGE REACTIONS. E.S.Amis.
J. chem. Phys., Vol. 26, No. 4, 880-1 (April, 1957).

The Np(V)-Np(VI) electron exchange reaction has been found to be independent of the composition and of the gross properties, dielectric constant, refractive index, viscosity, etc., of two mixed solvents. To account for these phenomena, the critical complex is assumed to consist of a region containing the reactant ions and the solvent component of highest dielectric constant. This component preferentially solvates the ionic reactants. In this region, complete dielectric saturation is also assumed. A.

541.126

5697. STUDY OF THE THERMAL DECOMPOSITION OF METHANE. F.W.Cagle, Jr.
J. chem. Phys., Vol. 25, No. 6, 1300-1 (Dec., 1956).

A study of existing data on the pyrolysis of methane mixtures with nitrogen and with water vapour reveals that nitrogen and water are more efficient "third" bodies for the reaction than is methane itself. W.Good

541.126

5698. KINETICS OF REACTION BETWEEN HYDROGEN AND NITROGEN DIOXIDE. W.A.Rosser,Jr and H.Wise.
J. chem. Phys., Vol. 26, No. 3, 571-6 (March, 1957).

The gas-phase reaction between hydrogen and nitrogen dioxide has been studied in the temperature range from 600 to 700°K. The stoichiometry of the reaction corresponds closely to $H_2 + NO_2 = NO + H_2O$. The rate of disappearance of NO_2 is given by

$$\frac{-d(NO_2)}{dt} = \frac{10^{14}(NO_2)(H_2)^{1.4}e^{-46\,000R/T}}{(NO_2) + (NO)}$$

The experimental observations are interpreted in terms of a chain mechanism involving hydrogen atoms and hydroxyl radicals as chain carriers. A.

541.127

5699. BURNING-RATE STUDIES. A NEGATIVE PRESSURE EXPONENT IN THE CONSUMPTION-RATE EQUATION FOR A LIQUID SYSTEM. A.G.Whittaker, H.Williams and P.M.Rust.
J. chem. Phys., Vol. 26, No. 3, 717-18 (March, 1957).

The kinetics of combustion of nonstoichiometric mixtures of 2-nitropropane and 95% nitric acid have been studied. Normally the consumption rate (C) increases with pressure (P) according to $C = kP^n + b$, where k, n, and b are positive constants. The results show that n may be negative over a limited pressure range. G.Allen

ELECTROCHEMISTRY 541.13

541.133

5700. STOKES' LAW. I. CONDUCTIVITIES OF ORGANIC IONS. J.T. Edward.
Sci. Proc. Roy. Dublin Soc., Vol. 27, No. 9, 273-82 (Oct. 15, 1956).

The equivalent conductances, Λ_+, recorded in the literature for 32 mono- and divalent ammonium ions in water at 25° fit reasonably well the equation $\Lambda_+ = 110\ z/r_C$, where r_C is the van der Waals radius of the ion, corrected if necessary for a non-spherical shape, and z is its valency. This equation may be derived theoretically if the frictional resistance f to the movements of these ions is given by the modified Stokes' equation: $f = 5.0\,\pi\, r_C\,\eta\, u$, where u is the velocity of the ion and η the viscosity of water. The same equations apply, although with less precision, to the conductances of carboxylate ions recorded in the literature, if it is assumed that the carboxylate group binds an inner sheath of water molecules, and causes breakdown of the water structure in an outer zone; it is further necessary to assume that other polar groups such as hydroxyl and cyano can lead to local breakdown of the water structure. A.

541.135.5 : 537.533.2

5701. ELECTROLYTIC HYDROGEN EVOLUTION KINETICS AND ITS RELATION TO THE ELECTRONIC AND ADSORPTIVE PROPERTIES OF THE METAL. B.E.Conway and J.O'M.Bockris.
J. chem. Phys., Vol. 26, No. 3, 532-41 (March, 1957).

A significant correlation between the logarithm of the exchange current density i_0 of the electrolytic hydrogen evolution reaction and the electronic work function ϕ is found for one group of metals. Another group of metals probably having a different relationship is distinguished. The relationship between $\log i_0$ and ϕ is explained as arising from the dependence of heat of adsorption upon ϕ. The bond strength D_{MH} of the adsorbed hydrogen calculated from Pauling's equation is less than the experimental value, owing to the neglect of the image potential of H at the metal, but parallels the experimental values. D_{MH} is dependent on the work function since the parameters D_{MM} (the metal–metal dissociation energy) and X_M (the electronegativity of the metal) are statistically significant linear functions of ϕ. For the metals Ta, Mo, W, Cu, Ni, Fe, Rh, Pd, and Pt (at high current densities) $\log i_0$ increases as the heat of adsorption of H decreases. The heats of adsorption of H at Hg, Cd, Pb and Tl are low compared with the values for other metals having respectively similar work functions and the distinct relation, having a different direction, between $\log i_0$ and ϕ for these metals is explained. $\log i_0$ increases linearly with increase of d character for the metals Mo, W, Cu, Ni, Fe, Pd, and Rh. The correlation coefficient is 0.62. The relation to d character arises since the d character determines the heat of adsorption of H. The usually observed Tafel slope of 0.12 is consistent either with the rate determining reaction

$$H_3O^+ + e_0^- + M \rightarrow MH + H_2O \qquad (A)$$

or

$$H_3O^+ + MH + e_0^- \rightarrow H_2 + M + H_2O \qquad (B)$$

If A is rate determining, i_0 should increase with increase of the heat of adsorption of H; if B, the converse should occur. Hence, B is rate determining in acid solution for the metals, Cu, Ni, W, Mo, Ta, Fe, Pd, Rh, Pt (high current-density) and A for the metals Hg, Tl, and Pb. The available stoichiometric number data support this conclusion, which implies that during steady evolution of hydrogen, a maximum coverage of the metal by adsorbed H occurs under the condition that the electrode is in contact with liquid water. A general theory of electrolytic reduction and electrode poisoning is given. A mathematical analysis of the dependence of the rate of the proton discharge reaction in terms of the heat of adsorption of H, MH bond force constants, and internuclear distance, is given. A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.144

5702. C^{13}-ISOTOPE EFFECT IN THE PHOTOLYSIS OF ETHYL BROMIDE. H.L.Friedman, R.B.Bernstein and H.E.Gunning.
J. chem. Phys., Vol. 26, No. 3, 528-32 (March, 1957).

The photolysis of ethyl bromide in a tenfold excess of cyclopen-

tane has been studied over the temperature range, 30 to 250° C. Ethane is the principal volatile product of reaction. The quantum yield of ethane formation has been found to be unity at 30° C. An increase in apparent quantum yield to 1.5 at 250° C was observed. This increase is attributed to the greater absorption of the incident radiation at high temperatures. The C^{12} enrichment in the ethane product was 1.0070 ± 0.0008, and invariant in temperature. The isotope fractionation effect is explained on the basis of the higher absorption of C^{12}–C^{12}–Br over C^{12}–C^{13}–Br in the long wavelength region. A.

541.15

5703. THE OXIDATION OF FERROCYANIDE IONS IN AQUEOUS SOLUTIONS BY GAMMA RADIATION. X.Tarrago, É.Masri and M.Lefort.
C.R. Acad. Sci.(Paris), Vol. 244, No. 3, 343-6 (Jan. 14, 1957). In French.

Ferrocyanide ions at concentrations below 10^{-2} M are oxidized at pH < 11 to ferricyanide by gamma radiation. An initial G = 7.5 was found in aerated acid solutions. In the absence of air and pH 0.5, G = 0.95. In the absence of air at pH 12 ferricyanide was reduced. A small after-effect was observed. This was traced to the thermal reaction of hydrogen peroxide with ferrocyanide. The radiation reaction is more pH-dependent in the absence of oxygen than in aerated solutions. Solutions which had been made up several days before irradiation show a different response. At concentrations of 10^{-2} M and higher different reaction products appear and direct effect kinetics come into operation. M.Ebert

541.15

5704. THEORY OF RADIATION CHEMISTRY. IV. CHEMICAL REACTIONS IN THE GENERAL TRACK COMPOSED OF N PARTICLES. L.Monchick, J.L.Magee and A.H.Samuel.
J. chem. Phys., Vol. 26, No. 4, 935-41 (April, 1957).

For Pt III, see Abstr. 2774 (1957). The chemical reactions which occur in particle tracks are diffusion-controlled. In this paper a set of partial differential equations is presented which describes the dissipation of a track composed of N particles. These equations involve functions which can be interpreted as correlation functions for the relative distribution of the particles. A superposition approximation is introduced which greatly simplifies the equations and a method for obtaining the correlation functions is presented. As an example of application of these equations a model for the action of ionizing radiation on water is discussed. It is shown that the radiation chemistry of water is adequately described for reasonable values of the parameters of the model. A.

DISPERSIONS. COLLOIDS. ADSORPTION

541.18

541.182.5

5705. THE ELASTIC PROPERTIES OF DILUTE AQUEOUS GELS. L.J.Hastewell and R.Roscoe.
Brit. J. appl. Phys., Vol. 7, No. 12, 441-7 (Dec., 1956).

A study of elastic behaviour under shear stress below the yield value has been made on seven different gels covering a wide range of chemical constitution. The static rigidity of a gelatine gel was found to increase with temperature in accordance with the kinetic theory of elasticity for long-chain polymers, and a similar variation was found in the case of a bentonite gel. This suggests that even when the material dispersed in a gel consists of discrete particles a loose chain structure is formed which is mechanically similar to that existing in a polymer gel. The theory of elastic loss for solid cross-linked polymers developed by Kirkwood would thus appear to be applicable to these gels. This has been tested by a series of measurements on the dynamic rigidity and dynamic viscosity of all seven gels together with observations of their creep and static rigidity. In four cases the results are consistent with this theory, but in the others it appears that the spectrum of retardation times is broader than the theoretical spectrum. A.

541.183.1

5706. NUCLEAR MAGNETIC RESONANCE AS A METHOD FOR DETECTING RELAXATION PHENOMENA OF MOLECULES ADSORBED ON SURFACES. N.Fuschillo and J.G.Aston.
J. chem. Phys., Vol. 24, No. 6, 1277 (June, 1956).

541.183.26 : 533.1

5707. DIFFUSION AND GAS SORPTION RATES OBEYING THE ELOVICH EQUATION. T.Freund.
J. chem. Phys., Vol. 26, No. 3, 713 (March, 1957).

It is pointed out that a mechanism based on sorption by gaseou diffusion in the pores of a solid may be able to account for the Elovich type of rate law. This gives for the amount q of gas sorbe a time t: $\alpha q = \ln[(t + t_0)/t_0]$, where α and t_0 are constants. P.T.Landsber

CHEMICAL STRUCTURE 541.2/.6

541.

5708. RELATIONSHIP BETWEEN O–H BOND LENGTH AND O...O DISTANCE IN HYDROGEN BONDS. H.K.Welsh.
J. chem. Phys., Vol. 26, No. 3, 710-11 (March, 1957).

Further experimental values are available to test the relation derived by Lippincott and Schroeder (Abstr. 6587/1955) between th O–H bond length, r, and the O...O distance, R, for the hydrogen bo system O–H...O, and reasonable agreement is obtained. There is no apparent correlation between departures from predicted values and nonlinearity of the hydrogen bond. The relation between the shift $\Delta\omega$ of vibration frequency of the O–H bond and R is recalcula ed, but reported values are in better agreement with the original curve. A.J.M

541.57 : 539.1

PRESENT SITUATION OF QUANTUM CHEMISTRY.
See Abstr. 5535

541.57 : 539.152

BONDING INFERENCES FROM NUCLEAR SPIN RESONANCE
See Abstr. 5565

541.62 : 535.

5709. SPECTROSCOPIC STUDIES OF ROTATIONAL ISOMERIS IN FLUORINATED ETHANES. III. CF_2Cl–CF_2Cl AND CF_2Br–C R.E.Kagarise.
J. chem. Phys., Vol. 26, No. 2, 380-3 (Feb., 1957).

For Pt II, see Abstr. 3241 (1955). The phenomenon of rotatio isomerism has been studied by observing the temperature and sta dependence of their infrared absorption spectra in the 2-18 μ reg In CF_2Cl–CF_2Cl, the trans-isomer persists in the crystalline sol and is also the more stable form in the liquid and vapour states. The energy difference between the trans (C_{2h}) and gauche (C_2) for in the vapour was observed to be 500 ± 200 calories/mole. In CF_2Br–CF_2Cl, the selection rules for the two probable isomeric species (C_s and C_1) are not sufficiently different to facilitate a di determination of the symmetry of the form which persists in the solid state. However, a comparison of the infrared spectrum of CF_2Br–CF_2Cl with those of CF_2Cl–CF_2Cl and CF_2Br–CF_2Br ind cates that the persistent isomer is the pseudo-trans-form (C_s sym metry). This trans-form is also the more stable isomer in both liquid and vapour phases, the energy difference being 520 ± 200 a 600 ± 200 calories/mole, respectively.

541.64 : 539

5710. CALCULATION OF COMPRESSIBILITIES OF HIGH POLYMERS FROM THE ENERGY OF INTERACTION BETWEEN CHAIN GROUPS. W.Brandt.
J. chem. Phys., Vol. 26, No. 2, 262-70 (Feb., 1957).

A potential function for the interaction of long chain molecul in polymer lattices is formulated. The adopted model assumes polymeric substances to consist of imperfect assemblies of perfe chain crystals. The chains are infinitely long compared to the ra of intermolecular forces so that end effects can be neglected. Ea chain is composed of evenly spaced dipolar dispersion force cent with dipole orientations perpendicular to and alternating along th chain axes. Pairs of force centres in neighbouring chains intera according to a Lennard-Jones (12-6) potential and the electrostat interaction terms. The interaction between neighbouring force centres within a chain is assumed to be Hookian with a force con stant calculated from combined valence bond distortions and vale angle deformations. The lattice energies of five linear polymers are calculated. It is found that the contributions from induction terms are negligible. The contributions from dipole interaction terms depend on the mutual orientation of the chains and amount only ~0.1-1% of the lattice energies. To this accuracy, certain

structure insensitive" properties can be described by an equation of corresponding intermolecular states. This approach is shown to fail, if applied to "structure sensitive" properties, which depend strongly on the interplay of inter- and intramolecular degrees of freedom. Absolute calculations of specific polymer volumes over large pressure ranges are in agreement with experiment. A.

541.64 : 536.7

5711. THEOREM OF CORRESPONDING STATES FOR POLYMERS. I.Prigogine, A.Bellemans and C.Naar-Colin.
J. chem. Phys., Vol. 26, No. 3, 710 (March, 1957).

A generalized theorem is derived, and may be employed to find the thermodynamic properties of polymers from experimental data on monomers. A.J.Mee

541.64 : 536.7

5712. STATISTICAL THERMODYNAMICS OF R-MER MIXTURES. A.Bellemans, C.Naar-Colin and I.Prigogine.
J. chem. Phys., Vol. 26, No. 3, 712 (March, 1957).

A theorem of corresponding states for r-mers, derived in the preceding abstract has been extended to r-mer mixtures in the same way as the theorem of corresponding states for spherical molecules was applied to mixtures, by introducing average molecular interactions. R.C.Murray

541.64 : 536.7

5713. THEOREM OF CORRESPONDING STATES FOR POLYMERS. I.Prigogine, A.Bellemans and C.Naar-Colin.
J. chem. Phys., Vol. 26, No. 4, 751-5 (April, 1957).

A theorem of corresponding states for polymers (r-mers) is derived for condensed states (liquid and solid). This theorem permits to correlate the thermodynamic properties of an homologous series of r-mer molecules. It gives satisfactory results when applied to the n hydrocarbons series. A.

541.64 : 532.77

HYDRODYNAMIC PROPERTIES AND NON-NEWTONIAN VISCOSITY OF SOLUTIONS OF MACROMOLECULAR CHAINS.
See Abstr. 5107

541.67 : 538.222

5714. SATURATION AND RELAXATION TIME IN THE PARAMAGNETIC ELECTRON RESONANCE OF SUGAR CHARCOALS. J.Uebersfeld and E.Erb.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2043-4 (Dec. 17, 1956). In French.

The effect of O_2 on the strength of the electron resonance of sugar charcoals (Abstr. 1717/1957) is shown to be a reduction of T_1, and a consequent removal of saturation, rather than a change in the number of free spins. D.H.Whiffen

541.67 : 548

5715. THE CHEMISTRY AND CRYSTAL STRUCTURE OF FERRITES AND OTHER MAGNETIC OXIDES. A.J.E.Welch.
Proc. Instn Elect. Engrs, Paper 2261R, publ. 1957, (Part B Suppl. No. 5, 138-40, 174-8).

A brief review is given of magnetic oxides of the principal structure types, and of the chemical techniques used in their synthesis. Fields are indicated in which further chemical and crystal-structure investigations are needed. Recent work on spinel solid-solutions, gamma ferric oxide, cadmium ferrite, lead ferrites, and strontium "ferrate" is summarized, and the preparation of small single crystals of nickel-zinc ferrites is described. A.

CHEMICAL ANALYSIS 543/545

545.66 : 536.423.15

5716. MASS SPECTRUM AND VAPOR PRESSURE OF PENTABORANE-d_9. I.Shapiro and J.F.Ditter.
J. chem. Phys., Vol. 26, No. 4, 798-801 (April, 1957).

The complete mass spectrum of pentaborane-d_9 and a partial mass spectrum of pentaborane-d_8 have been calculated from the spectra of a series of samples of different hydrogen content. The vapour pressure for pentaborane-d_9 containing 3.9% of the B_5D_8H species can be expressed by the equation $\log_{10}P_{mm} = 9.46916 - 0.0028783T - 1870.70/T$ over the temperature of -25°C to $+56^\circ$C. The melting point is -47.0°C. By way of comparison the vapour pressure equation for pentaborane is $\log_{10}P_{mm} = 9.49191 - 0.0028956T - 1881.29/T$; the melting point is -46.8°C. A.

CRYSTALLOGRAPHY 548

548.4 : 537.311.33

5717. THE DETERMINATION OF GASEOUS MICRO-IMPURITIES IN SURFACE LAYERS OF GERMANIUM.
S.M.Faĭnshteĭn and V.I.Fistul'.
Zh. tekh. Fiz., Vol. 26, No. 10, 2162-4 (1956). In Russian.

Thin Ge plates etched in various reagents and dried at 120°C were heated at 600°C, the vapours then evolved (largely H_2O and $CO + N_2$) being analysed mass-spectrometrically. The results were interpreted in terms of surface adsorptivity. The etch giving least vapour was H_2O_2—oxalic acid, CP-4 giving nearly three times and H_2O_2-caustic soda over eight times the amount. Traces of methane were evolved from a CP-4 etched surface. C.H.L.Goodman

548.52

5718. THE PHENOMENON OF CRYSTALLIZATION IN STATISTICAL PHYSICS. É.A.Arnshteĭn.
Dokl. Akad. Nauk SSSR, Vol. 112, No. 4, 615-18 (1957). In Russian.

Studies the phenomenon of crystallization, using Bogolyubov's method (Problems of dynamical theory in statistical physics, 1946, in Russian), claimed to link the thermodynamical functions with structure. As a result of a number of physical assumptions and mathematical transformations, the author obtains an inequality for the condition of stability, which is applied to the particular case of cubic face-centred lattice; the line of continuous transition is derived for this case. F.Lachman

548.52 : 539.234

5719. ON THE TEXTURE OF EVAPORATED FILMS. R.B.Kehoe.
Phil. Mag. (Eighth Ser.), Vol. 2, 455-66 (April, 1957).

Copper, silver and gold have been evaporated on to heated cleavage surfaces of alkali halide crystals in an electron diffraction camera. The diffraction patterns have been studied continuously as the depositions were carried out and the crystalline arrangement in the films has been deduced as a function of thickness. When the growth is epitaxial the orientations are predominantly parallel, with subsidiary twinning and the (112) orientation. The proportion of the latter orientations, the crystal size and the degree of disorientation at different levels in the films may vary considerably. Single crystal growth by evaporation is found in certain cases to cease beyond a certain thickness; an explanation of this is put forward. Fine structure effects have been observed in the patterns. These effects have been analysed in some detail, and possible explanations are suggested. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

5720. ON THE NAOR RELATIONS BETWEEN MADELUNG CONSTANTS FOR CUBIC IONIC LATTICES. F.G.Fumi and M.P.Tosi.
Phil. Mag. (Eighth Ser.), Vol. 2, 284-5 (Feb., 1957).

See Abstr. 11257 (1954). Two simple proofs of Naor's relations are given. A.R.Stokes

548.7

5721. LATTICE DYNAMICS OF HEXAGONAL CLOSE-PACKED METALS. L.J.Slutsky and C.W.Garland.
J. chem. Phys., Vol. 26, No. 4, 787–93 (April, 1957).

The lattice dynamics of hexagonal close-packed metals has been investigated, the assumption being made that the atoms interact with central forces. Atomic force constants are related to the elastic constants by the method of homogeneous deformation in which the contribution of the electron gas to the elastic constants is assumed to arise from an isotropic volume-dependent term in the energy. Relations are given for the propagation of acoustical waves in hexagonal crystals which permit calculation of the elastic constants from ultrasonic pulse velocity measurements. A.

548.7 : 536.631

5722. VIBRATION SPECTRUM AND HEAT CAPACITY OF A CHAIN POLYMER CRYSTAL. S.M.Genensky and G.F.Newell.
J. chem. Phys., Vol. 26, No. 3, 486-97 (March, 1957).

The Born–von Karman model for a chain polymer crystal previously studied by Stockmayer and Hecht is re-examined using only analytic approximations rather than numerical methods. The analytic approach brings out many peculiar properties of the chain polymer model that did not appear in the numerical treatment. One branch of the frequency distribution $g(\nu)$ is shown to be proportional to ν^2 for the smallest values of ν, approximately proportional to $\nu^{3/2}$ for slightly larger ν, to $\nu^{1/2}$ for still larger ν and to $\nu^{-1/2}$ in still a fourth range of small values of ν. An accurate graph of $g(\nu)$ is constructed for the entire range of frequencies using values of the force constants suggested by Stockmayer and Hecht. $g(\nu)$ is shown to have approximate singularities of a type not anticipated by van Hove in his broad treatment of singularities for general systems. This anomalous behaviour results from having strong valence forces resisting the bending of bond angles. A classification and description of various kinds of singularities that may arise for systems with strong valence forces are given in an appendix. A.

548.7

5723. ELECTROSTATIC POTENTIAL IN CRYSTALS. E.Callen.
Amer. J. Phys., Vol. 25, No. 3, 138-49 (March, 1957).

The electronic potential distribution at the surface of a crystal is described. The periodic potential of the interior is modified at the surface by a redistribution of charge, which may be developed in terms of a number of related dipole double layers, space charge, and net surface charge. The image, exchange, and correlation fields, and the field of the net surface charge are presented. The relationship of these effects to the work function of metals and nonmetals, and their role in rectification in metal–semiconductor contacts is mentioned. A.

548.7

5724. THE ELECTRON DENSITY OF THE THOMAS–FERMI ATOM IN CRYSTALS. M.Atoji.
J. Phys. Soc. Japan, Vol. 11, No. 11, 1204-5 (Nov., 1956).

Theoretical. It is shown that at absolute zero temperature very small vibrations of the atoms in a copper crystal produce striking modifications to the calculated electron density of the Thomas–Fermi model at the origin. When thermal vibrations are appreciably large the Thomas–Fermi electron distribution of atoms tends to become identical to those obtained from the Duncanson–Coulson wave functions. J.Iball

548.7

5725. GROUP-THEORETICAL TREATMENT OF THE ENERGY BANDS IN METAL BORIDES MeB_6. M.Yamazaki.
J. Phys. Soc. Japan, Vol. 12, No. 1, 1-6 (Jan., 1957).

The tight-binding approximation is applied to a study of electronic energy bands in metal borides MeB_6. The 25 x 25 determinantal secular equation for the energy is reduced by a group-theoretical treatment of the spatial symmetry at certain special values of the wave-vector. The results are that, if metal atoms have two valence electrons, the valence bands are all filled and the conduction bands are all empty, and in the case of calcium boride CaB_6 the narrowest gap between valence and conduction bands is at the edges of the first Brillouin zone, simple cube in the reciprocal space, and its width is a about 1.5 eV in good agreement with the empirical fact that there exist only borides of elements having two valence s-electrons in this type of structure. A.

548.7

5726. CAPTURE OF CONDUCTION ELECTRONS BY CHARGED DEFECTS IN IONIC CRYSTALS. Yu.E.Perlin.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 105-14 (1957). In Russian.

Capture of a conduction electron by charged defects of an ionic crystal lattice is considered as a one-quantum thermal transition from a continuous spectrum to the excited state of a discrete spectrum. The role of the perturbation is played by the nonconfiguratio interaction which in an ideal crystal leads to usual polaron scattering. The capture probability as a function of polaron velocity has been computed and the temperature dependence of the lifetime of the current carriers has been established. A

548.7

5727. NUCLEAR POLARIZATION AND IMPURITY-STATE SPIN RELAXATION PROCESSES IN SILICON. D.Pines, J.Bardeen and C.P.Slichter.
Phys. Rev., Vol. 106, No. 3, 489-98 (May 1, 1957).

Two proposals are made for producing nuclear polarization by transient analog of the Overhauser effect in the impurity-state electron spin resonance in silicon. The success of the proposed po larization schemes requires that the electron spin relaxation proce in which the impurity nucleus and the electron simultaneously flip their spins to be faster than those relaxation processes in which an electron alone changes it spin. A detailed study of many electron spin relaxation processes is carried out. It is found that for suffic ently low concentrations of P, As, and Sb impurities in silicon tran sient nuclear polarization should occur; for Li impurities it should not. The foregoing theoretical predictions have been verified for A by the recent experiments of Abragam and Combrisson, and of Feh A

548.

5728. ON THE SHAPE OF PARAMAGNETIC RESONANCE ABSORPTION CURVES IN CRYSTALS. G.Ya.Glebashev.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 82-6 (1957). In Russian.

The sixth-order moment of the paramagnetic resonance absor ion curve in crystals at high frequency has been calculated. Com- parison of the computed fourth and sixth-order moments with the e perimental values confirms the theory of exchange narrowing. The exchange interaction coefficients thus obtained are smaller than those which are obtained by comparing the Van Vleck and Opechow formulae for magnetic specific heat and the Curie temperature wit static susceptibility measurements. A

548

5729. OBSERVATION OF HELICOIDAL DISLOCATION LINES I FLUORITE CRYSTALS. W.Bontinck and S.Amelinckx.
Phil. Mag. (Eighth Ser.), Vol. 2, 94-6 (Jan., 1957).

Helical dislocations and dislocation rings have been observed CaF_2 by the technique of "decoration". It is shown how a helical dislocation is formed when a mixed dislocation line, which is anchored at both ends, climbs. The intersection of the windings o the helix with other suitable dislocations can result in the detachment of closed loops. A.B.Lidiar

548

5730. ON THE FORMATION AND PROPERTIES OF HELICAL DISLOCATIONS. S.Amelinckx, W.Bontinck, W.Dekeyser and F.Seitz.
Phil. Mag. (Eighth Ser.), Vol. 2, 355-78 (March, 1957).

The factors influencing the development of helical dislocation found in CaF_2 by Bontinck and Amelinckx (see preceding abstract) are discussed. At temperatures near and below 700°C the princip electrolytic current in CaF_2 appears to be carried by the negative ions. Thus climb of dislocations is difficult to produce as a resul of processes inducing electrolytic flow. It is proposed that the po tive ions carry a larger component of the current near 1200°C an that maintenance of the electrolytic currents induced during additi coloration produce what might be termed mild climb. Under this climb dislocations having a strong screw component are induced t assume a helical or spiral prismatic form as proposed earlier by Seitz. The model of F-centres in CaF_2 and their equilibrium characteristics are discussed. It is pointed out that helical dislo tions should be generated in many materials under a wide variety circumstances in which climb occurs and that such dislocations a in principle at least, capable of generating whiskers when they oc sufficiently near the surface. Such whiskers would grow from the base and should possess many of the attributes found in the whisk of this type which are observed in practice. It is proposed that co trolled climb of any material may be produced with the use of an appropriate temperature gradient if the production of annihilation lattice defects at the dislocations engenders climb and if the production lies in an attainable temperature range.

548.7

5731. CLIMB PHENOMENA IN SYNTHETIC FLUORITE CRYSTALS. W.Bontinck.
Phil. Mag. (Eighth Ser.), Vol. 2, 561-7 (April, 1957).

Results of experiments in connection with climb of dislocations in fluorite crystals are given. Peculiarities of helical dislocations are explained. Observations concerning rows of closed loops and special features are described and discussed. Double rows of etch-pits were identified with the emergence points of the parts of helical dislocations obtained by cleaving through helices. A.

548.7

5732. AN EXCITON STATE OF AN IMPERFECT MOLECULAR CRYSTAL. A.S.Selivanenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 75-81 (1957). In Russian.

A solution of Schrödinger's equation for a semi-infinite molecular crystal is presented. Exciton waves localized on a surface have been obtained. The energy spectrum of surface exciton is presented. A.

548.7

5733. THE FIELD MASS OF POLARIZING EXCITONS IN IONIC CRYSTALS. I.M.Dykman, E.I.Kaplunova and K.B.Tolpygo.
Zh. tekh. Fiz., Vol. 26, No. 11, 2459-66 (1956). In Russian.

The effective mass of a polarizing exciton in an ionic crystal has been calculated on the assumption that it is of a field character and is conditioned by the interaction of the exciton and the lattice vibrations. For excitons of large radius the calculation is carried out by a macroscopic approximation and for excitons of small radius for NaCl and KCl taking account of the discrete structure of the crystals and the dispersion of the proper modes of vibration on the basis of a model proposed earlier (I.M.Dykman, Trudy Instituta Fiziki Akademii Nauk Ukrainskoĭ SSR, Vol. 5, 48, 1954). A.L.Mackay

548.7

5734. ON THE OSCILLATOR STRENGTH OF V_2 CENTERS IN POTASSIUM IODIDE CRYSTAL. Y.Uchida, Y.Nakai and T.Tomotika.
J. Opt. Soc. Amer., Vol. 47, No. 3, 246-9 (March, 1957).

By measuring the absorption of dilute aqueous solutions of KI with various known amounts of pure iodine added, it has been observed that the absorption coefficient at a wavelength of about 350 mμ is nearly proportional to the amount of iodine in the solution. Making use of this fact, the amount of excess iodine in an additively V-coloured KI crystal has been obtained. Taking into account that two iodine atoms are associated with a V_2 centre, the oscillator strength of the absorption band at 365 mμ has been estimated to be 1.10 ± 0.16 by the Smakula formula. A.

548.7

5735. TRANSPARENT POLYCRYSTALLINE ALKALI HALIDE PELLETS IN COLOR CENTER EXPERIMENTS. H.N.Hersh.
J. Opt. Soc. Amer., Vol. 47, No. 4, 327-8 (April, 1957).

Pressed pellets, made from dry powder of uniform crystallite size, have been used in colour centre studies. A pellet of KI showed a long tail to the ultraviolet absorption edge compared to a single crystal of KI, and the ratio of F to V band absorption in an X-irradiated pellet was also different. On the other hand the absorption spectrum of a KI:TlI pellet is similar to that of a single crystal. A.B.Lidiard

548.7

5736. A NEW ATTEMPT TO INTERPRET COLOUR CENTRE PHENOMENA. D.Saint-James.
J. Phys. Radium, Vol. 17, No. 10, 907-8 (Oct., 1956). In French.

A model is established which assumes parts of those due to Seitz and to Varley. Multiple ionization is assumed to occur in X-ray bombardment (Varley). The theory provides a more satisfactory explanation of V-centre characteristics. G.F.J.Garlick

548.7

5737. ELECTRONIC STRUCTURE OF F-CENTERS IN KCl BY THE ELECTRON SPIN DOUBLE-RESONANCE TECHNIQUE. G.Feher.
Phys. Rev., Vol. 105, No. 3, 1122-3 (Feb. 1, 1957).

The electron resonance of an F-centre in KCl at 9000 Mc/s in a field of 3000 Oe was partially saturated and the nuclear hyperfine levels detected by simultaneous irradiation in the 3.4 to 6.2 Mc/s range. When the frequency is correct for radiofrequency transitions the microwave signal is affected and the nuclear spacing can be measured with good accuracy. For K^{39} the Hamiltonian parameters are a = 21.6 Mc/s; b = 0.95 Mc/s, Q' = 0.20 Mc/s. For the Cl^{35} coupling a = 7.0 Mc/s, b = 0.50 Mc/s and two of the asymmetric quadrupole tensor elements are shown to be 0.032 and 0.045 Mc/s. D.H.Whiffen

548.7 : 535.37

STRESS-ACTIVATED LUMINESCENCE IN X-IRRADIATED ALKALI HALIDE CRYSTALS. See Abstr. 5213

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73 : 536.48

5738. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON LOW TEMPERATURE CRYSTALLOGRAPHY — OXFORD, APRIL, 1956. D.W.J.Cruickshank, E.Mendoza and J.H.Robertson.
Brit. J. appl. Phys., Vol. 7, No. 12, 425-35 (Dec., 1956).

A joint conference of the X-ray Analysis Group of The Institute of Physics, and the Low Temperature Group of the Physical Society. The theme included the study of structure and associated properties at low temperature, phase transitions, specific heat, thermal vibrations and absorption spectra, in both theoretical and experimental aspects. A.

548.732

5739. INTENSITY DISTRIBUTION OF THE X-RAY DIFFRACTION PATTERN OF A FINITE CRYSTAL CONTAINING POINT DEFECTS. J.B.Sampson and C.W.Tucker, Jr.
Phys. Rev., Vol. 105, No. 3, 1117-18 (Feb. 1, 1957).

It is shown that the effect of finite crystal size is to make the displacement of the diffraction lines greater than one would expect for an infinite crystal, but to leave the diffuse background unaltered. A.R.Stokes

548.735

5740. MICROSTRUCTURE OF PHOTOCONDUCTIVE LEAD SULPHIDE LAYERS. A.Feltynowski, I.Glass, T.Piwkowski and A.Toruń.
Acta phys. Polon., Vol. 15, No. 5, 275-82 (1956).

The microstructure of PbS layers has been investigated by means of electron diffraction and electron microscopy. The PbS layers were obtained by evaporating in vacuo. The specimens to be examined were prepared by the method of formvar pseudo-replicas or directly by evaporation on thin films of formvar, collodion or aluminium. In general, the PbS layers consist of crystals 200-300 A in size; no influence of the substratum on the size or shape of these crystals has been observed. The diffraction patterns of layers deposited directly by evaporation correspond to a regular face-centred lattice of the NaCl type. The diffraction patterns of the pseudo-replicas show characteristic departures from this structure consisting of a decrease in the diameter of the 200 ring and an increase in the diameter of the 220 ring as compared with the diameters of the remaining rings. A.

548.735

5741. VECTOR CONVERGENCE IN THE NONCENTROSYMMETRIC $|F|^2$ SERIES. W.N.Lipscomb.
J. chem. Phys., Vol. 26, No. 3, 713-14 (March, 1957).

A combination of the vector convergence method (Acta cryst., Vol. 3, 164, 1950) and the anomalous X-ray scatterer method (Abstr. 1754/1957) is described, and its applicability to crystals with space-groups $P2_1$ and $P2_12_12_1$ considered. A.R.Stokes

548.735.44 : 518.5

COMPUTING MACHINE FOR FOURIER'S SYNTHESIS. See Abstr. 3895

548.736

5742. CLASSIFICATION OF PEROVSKITE AND OTHER ABO_3-TYPE COMPOUNDS. R.S.Roth.
J. Res. Nat. Bur. Stand., Vol. 58, No. 2, 75-88 (Feb., 1957).

A classification of $A^{+2}B^{+4}O_3$ compounds has been made on the basis of ionic radii of the constituent ions. A graph of this type for the perovskite compounds can be divided into orthorhombic, pseudo-cubic, and cubic fields, with an area of ferroelectric and antiferroelectric compounds superimposed on the cubic field. The structures of solid solutions between various perovskite compounds cannot be completely correlated on the basis of this simple two-dimensional chart. Therefore, a new type of classification of the perovskite-type compounds has been attempted, using a three-dimensional graph with polarizability of ions plotted as the third dimension. This three-dimensional graph has been applied successfully to compounds of the type $A^{+2}B^{+4}O_3$, which crystallize with perovskite-type structures. In addition, a classification of double oxides of trivalent ions has shown that all compounds of this type having the perovskite structures can be divided into two groups, with rhombohedral and orthorhombic symmetry. No ideal cubic perovskites of the $A^{+3}B^{+3}O_3$ compounds have been found. A.

548.736.3

5743. X-RAY DIFFRACTION STUDY OF THE CUBIC PHASE OF ICE. F.V.Shallcross and G.B.Carpenter.
J. chem. Phys., Vol. 26, No. 4, 782-4 (April, 1957).

An X-ray diffraction study has been made of the cubic phase of ice previously reported by König from electron diffraction work. Cubic ice could be obtained only by direct crystallization from the vapour on to surfaces at low temperature. Condensation rate and surface conditions are critical variables in the formation of cubic ice. Powdered mixtures of cubic and hexagonal ice were studied at -19° and -13°C. The powder X-ray patterns confirm the diamond structure for the oxygen atoms; the cubic cell edge is a = 6.37 ± 0.02 A at -190°C. A.

548.736.3

5744. THE CUBIC AND OTHER STRUCTURAL FORMS OF ICE AT LOW TEMPERATURE AND PRESSURE.
M.Blackman and N.D.Lisgarten.
Proc. Roy. Soc. A, Vol. 239, 93-107 (Feb. 12, 1957).

Deposits have been prepared by injecting water vapour on to a base at low temperatures in an electron-diffraction camera. Three types of diffraction patterns are found, depending on the temperature of the base. Below -140°C diffuse rings are obtained, between -140 and -120°C a sharp ring pattern characteristic of the diamond-type cubic pattern, and above -100°C the normal hexagonal pattern of ice also in the form of sharp rings. Deposits were also formed from the residual vapour in the camera, the method originally used by König. It is found that these deposits evaporate at a much higher temperature than those produced by injection, which suggests that these deposits are associated with some form of contamination. Experiments were also carried out with heavy water. The results are almost identical with those for ordinary water. The same three structural forms are produced under similar conditions, at temperatures which are slightly higher than those for ordinary water. A.

548.736.4 : 537.226.2

STRUCTURE AND PHASE TRANSITIONS OF FERROELECTRIC SODIUM–LEAD NIOBATES AND OF OTHER SODIUM NIOBATE TYPE CERAMICS. See Abstr. 5298

548.74

5745. PROTON POSITIONS IN $CuCl_2.2H_2O$ BY NEUTRON DIFFRACTION. S.W.Peterson and H.A.Levy.
J. chem. Phys., Vol. 26, No. 1, 220-1 (Jan., 1957).

Neutron diffraction measurements on single crystals of $CuCl_2.2H_2O$ at room temperature give data that are incompatible with the proton positions but forward by Poulis and Hardeman (Abstr. 5899/1952; 2910/1954) but, when used as a basis for the interpretation of their magnetic resonance data below 4°K, are consistent with the conclusion of Rundle that the magnetic moments are not localized on Cu. A direct determination of the magnetic ordering by a neutron diffraction study of the antiferromagnetic phase still remains to be carried out. J.Thewlis

548.74

5746. NEUTRON DIFFRACTION STUDY OF CALCIUM HYDROXIDE. W.R.Busing and H.A.Levy.
J. chem. Phys., Vol. 26, No. 3, 563-8 (March, 1957).

Single crystal neutron diffraction measurements on $Ca(OH)_2$ at 20°C and -140°C confirm the X-ray structure and the hydrogen positions previously postulated. Refinement of the neutron data by Fourier and least-squares procedures yields a detailed description of the thermal motions. The amplitudes of the motion of the hydrogen atoms are compared with those deduced from infrared and Raman studies. The O–H distance, after allowance for asymmetric thermal motion, is 0.984 A. A.

548.74

5747. THERMAL INELASTIC SCATTERING OF COLD NEUTRONS IN POLYCRYSTALLINE GRAPHITE.
L.S.Kothari and K.S.Singwi.
Phys. Rev., Vol. 106, No. 2, 230-4 (April 15, 1957).

The temperature variation of the thermal inelastic scattering cross-section of cold neutrons in graphite, calculated on the assumption of a Debye frequency spectrum, is in disagreement with experiments. This is not surprising in view of the highly anisotropic nature of its lattice. In this paper formulae of the scattering cross-section obtained earlier have been modified, for the case of an anisotropic layer lattice. Using the Krumhansl and Brooks model of graphite (Abstr. 417/1954) with the values of the parameters occurring in their theory as fixed by Keesom and Pearlman (Abstr. 8714/1955) on the basis of their specific heat measurements at low temperatures, the inelastic scattering cross-section has been calculated for 10 A neutrons as a function of temperature. The calculated values are in reasonably good agreement with the experimental results of the Brookhaven group. For room temperature the variation of the scattering cross-section with neutron wavelength has been calculated, and it is in disagreement with the observed variation. This discrepancy may partly be due to small-angle scattering arising from the finite grain size of carbon. A.

548.74

5748. STUDY OF SIMULTANEOUS REFLEXION IN ELECTRON DIFFRACTION BY CRYSTALS. I. THEORETICAL TREATMENT. K.Kambe.
J. Phys. Soc. Japan, Vol. 12, No. 1, 13-25 (Jan., 1957).

The simultaneous reflection by two lattice planes (with indices h and h') in electron diffraction has been treated by the dynamical theory in order to investigate how it is influenced by the phases of structure amplitudes. For convenience of treatment, a modified formulation of the theory has been developed using particular cross-sections of the dispersion surface in reciprocal space. Applying the theory to a lamellar crystal, it was proved that the intensities of transmitted and diffracted waves depend in a relatively simple way on the value of $|\Phi_{hh'}| = |\varphi_h - \varphi_{h'} + \varphi_{h'-h}|$, where φ_h, $\varphi_{h'}$, and $\varphi_{h'-h}$ are the phase angles of structure amplitudes for the indices h, h', and h' – h. It was shown that the phase effect can be most easily demonstrated by observing fine structures of reflection spectra which are obtained by rotating the crystal in a specified manner. The determination of the value of $\Phi_{hh'}$ is simplest when the coupling reflection h' – h is strong compared with the reflections h and h', and the crystal is centrosymmetric. A.

548.74

5749. STUDY OF SIMULTANEOUS REFLEXION IN ELECTRON DIFFRACTION BY CRYSTALS. II. EXPERIMENTAL CONFIRMATION. K.Kambe.
J. Phys. Soc. Japan, Vol. 12, No. 1, 25-31 (Jan., 1957).

The effect of the phases of structure amplitudes appearing in the simultaneous reflection in electron diffraction as predicted by the dynamical theory has been examined experimentally in convergent-beam electron-diffraction patterns of graphite. Anomalous structures of Kossel–Möllenstedt lines at their cross-points have been satisfactorily explained by the theory. Thus, it has been proved that the experimental determination of the phases of structure amplitudes is feasible by the observation of simultaneous reflection. These phase effects have been found also at the intersecting points of Kikuchi lines. A.

548.74

5750. ON ELECTRON DIFFRACTION WITH DIFFERENT WAVELENGTHS. S.Yamaguchi.
Z. Phys., Vol. 146, No. 4, 447-50 (1956). In German.

Experiments on ZnO smokes show that the degree of agglomeration of the crystal planes, which corresponds in different instances to thicknesses varying from 500 to 5000 A, may be assessed by studying the intensity changes in electron diffraction patterns obtained with electron beams of wavelength 0.02 to 0.05 A. The intensities observed by X-ray diffraction are similar to those for the hardest electrons only. Refraction, multiple scattering and absorption are all much smaller with these hard electrons. J.Thewlis

548.74 : 539.234 : 539.21

ELECTRON DIFFRACTION STUDY OF THIN FILMS OF METALLIC ALLOYS. See Abstr. 4803

GEOPHYSICS 55

550.385 : 523.752

INTERVAL OF TIME BETWEEN CHROMOSPHERIC ERUPTIONS AND GEOMAGNETIC PERTURBATIONS. See Abstr. 4997

550.83

5751. APPLICATION OF THE BACK-SCATTERING OF GAMMA-RAYS TO THE MEASUREMENT OF SOIL DENSITIES. J.Jacquesson.
J. Phys. Radium, Vol. 17, Suppl. No. 11, 176A-180A (Nov., 1956). In French.

For similar chemical compositions, the γ-ray intensity scattered depends on the distance between the source and detector and on the density. A principle of similarity is deduced and put into such a form that it can be used to examine density variations in soils. Some experimental results are appended. J.M.Hough

551.155.2

5752. DISTRIBUTION, PRODUCTION RATE, AND POSSIBLE SOLAR ORIGIN OF NATURAL TRITIUM. H.Craig.
Phys. Rev., Vol. 105, No. 3, 1125-7 (Feb. 1, 1957).

A preliminary report of calculations on tritium production rate which show that Libby's estimate (Abstr. 5885/1954) is too small owing to the deep sea residence-time being less that 1000 years. The new calculations yield values of 1.0 and 1.7 tritium atoms per cm^2 of earth surface per sec according to the assumptions made. These values are too great to be explained in terms of cosmic rays and it appears likely that tritium atoms are being accreted by solar emission. J.M.Hough

ATMOSPHERE. METEOROLOGY 551.5

551.508.92

5753. A NEW PRINCIPLE IN THE EXPERIMENTAL DETERMINATION OF OBLIQUE VISIBILITY. R.Gasnier and E.Vassy.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2118-20 (Dec. 17, 1956). In French.

Describes an experimental arrangement for the evaluation of visual range at oblique incidence through a bank of mist or thin fog. A pulsed light-source of very brief duration, e.g. an electric spark controlled by a Kerr cell, is projected by means of a parabolic mirror in the direction of the diffusing medium, is scattered backwards, collected by a second mirror, and focused on to a photomultiplier cell. The time-variation of intensity of the amplified output from the cell is fed to a cathode-ray oscillograph, and used to evaluate a function of the required visual range. D.R.Barber

551.510.535

5754. THE BEHAVIOUR OF A CHAPMAN LAYER IN THE NIGHT F_2 REGION OF THE IONOSPHERE, UNDER THE INFLUENCE OF GRAVITY, DIFFUSION, AND ATTACHMENT. R.A.Duncan.
Austral. J. Phys., Vol. 9, No. 4, 436-9 (Dec., 1956).

It is shown that, in the presence of diffusion, gravity, and attachment, a Chapman layer, no matter what its height, maintains its shape, decaying uniformly with an effective attachment coefficient equal to the true attachment coefficient at the height of the electron density maximum; and that, at the same time, the layer drifts bodily towards an equilibrium height. It is then shown that a uniform vertical tidal drift will alter the equilibrium height of a Chapman layer. A.

551.510.535

5755. MOTION IN THE NIGHT-TIME E_s REGION AT BRISBANE. J.A.Thomas and M.J.Burke.
Austral. J. Phys., Vol. 9, No. 4, 440-53 (Dec., 1956).

An analysis is made of night-time motion in the E_s-region, as determined from a study of radio echoes at 2.28 Mc/s. Night-time E_s usually consists of moving clouds of ionization of lateral extent ~ 10 km; these clouds may be either isolated or close-packed to form layers of ionization. There is evidence that the clouds are sometimes elongated in a direction different from their direction of travel. Good correlation is found between velocities of E_s movement as determined by fading analysis (Mitra, see Abstr. 622/1950) and direction-finding techniques. Speeds of movement are grouped about 70 m/sec, and the winds are predominantly towards the north. A.

551.510.535 : 523.164.32

5756. A RELATION BETWEEN THE IONIZATION OF THE E-LAYER OF THE IONOSPHERE AND SOLAR RADIO RADIATION. J.F.Denisse and M.R.Kundu.
C.R. Acad. Sci. (Paris), Vol. 244, No. 1, 45-7 (Jan. 2, 1957). In French.

A relationship between the monthly means of the critical frequency of the E-layer and the monthly averages of intensity of solar emission on 10.7 cm wavelength is demonstrated for the period 1947-53. The flux of ionizing radiations appears to be strictly proportional to the flux of radio radiation. M.W.Ovenden

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.1

5757. SOLAR RADIATION AND ATMOSPHERIC ATTENUATION AT 6 MILLIMETER WAVELENGTH. R.N.Whitehurst, J.Copeland and F.H.Mitchell.
J. appl. Phys., Vol. 28, No. 3, 295-8 (March, 1957).

A microwave radiometer of the Dicke type for the 6 mm wavelength range has been built and operated to measure radiation from the sun and attenuation in the earth's atmosphere. The total vertical attenuation in the earth's atmosphere on four clear summer days averages 1.2 dB. It is presumably due principally to oxygen, since the 6 mm wavelength is well up on one wing of the 5 mm absorption line. The quoted values are in agreement with a line-width constant of 0.02 cm^{-1}. Attenuation in clouds is highly variable. An additional 1 dB above the fair-weather value is typical for a thin overcast. Measurements during the summer of 1956 indicate an effective solar temperature of about 4500°K. This value is appreciably lower than temperatures reported at 7.5 and 8.5 mm, and it favours a model of the lower chromosphere which assumes temperatures well below the optical surface value of 5700°K. A.

551.521.13

5758. PRELIMINARY SPECTRORADIOMETRIC MEASUREMENTS OF THE SOLAR CONSTANT. R.Stair and R.G.Johnston.
J. Res. Nat. Bur. Stand., Vol. 57, No. 4, 205-11 (Oct., 1956).

Spectroradiometric measurements of the distribution of direct solar radiation at Sunspot, New Mexico (altitude 9 200 feet), are described. Detailed spectral data were obtained within the spectral range of 299 to 535 millimicrons for different air masses. At longer wavelengths radiant-energy evaluations were made only for selected points between the water-absorption bands. From these data, supplemented by other measurements and estimates for radiant-energy intensities for very short and very long wavelengths, a preliminary spectral integration of the total solar intensity yields a solar constant Q = 2.05 cal cm^{-2} min^{-1} in general agreement with the best published values. A.

551.521.2

5759. RADIATION MINIMUM TEMPERATURES. F.K.Davis,Jr.
Amer. J. Phys., Vol. 25, No. 3, 150-2 (March, 1957).

Frost resulting from cooling of vegetation by nocturnal radiation is a serious agricultural problem. Because of the number of variables involved, attacks on this problem from a purely theoretical point of view have met with only moderate success. It seems logical to suppose that an instrument might be devised which would speed up the natural radiation processes and enable an observer to obtain in a few hours a measure of the cooling which occurs naturally over a period of 12 to 14 hr. Such an instrument could serve as a frost warning device. This paper describes the construction of a radiation device and presents experimental evidence to show that it can be used as a predictor of freezing temperatures at vegetation level. A.

551.521.3

5760. ATMOSPHERIC TRANSMISSION IN THE INFRARED. J.H.Taylor and H.W.Yates.
J. Opt. Soc. Amer., Vol. 47, No. 3, 223-6 (March, 1957).

Infrared atmospheric transmission from 0.5μ to 15μ is shown as measured over three horizontal paths of 1000 ft, 3.4 statute miles, and 10.1 statute miles. The intense source, a 60 in. carbon-arc searchlight, permits a resolution throughout of about 10 wavenumbers. Work is continuing in an effort to obtain data taken under

a wide range of atmospheric and meteorological conditions. The data presented here represent an average relatively clear winter day, a moderately dense fog and a snowstorm. A.

551.521.326

5761. A POSSIBLE EXPLANATION OF THE DIURNAL VARIATION IN THE INTENSITY OF THE NIGHT GLOW LINE (O I) 5577 A. L.Liszka.
Acta phys. Polon., Vol. 15, No. 5, 305-10 (1956).

This paper discusses a possible explanation for the diurnal changes in the intensity of the green line of the night glow. These changes may be caused by periodic changes of pressure in the upper layers of the atmosphere arising from the tidal activity of the sun and the moon. The correctness of the above hypothesis can be confirmed by investigating the relation between the position of the moment of maximum green line intensity and the lunar phase. It can be seen from the curve drawn of the basis of published curves of the green-line intensity changes available to the author that such a relationship actually exists. A.

551.521.326

5762. THE EMISSION OF THE RED LINES OF O I IN THE UPPER ATMOSPHERE. R.Robley.
C.R. Acad. Sci. (Paris), Vol. 243, No. 25, 2120-2 (Dec. 17, 1956). In French.

Using a Blamont–Courtès photometer (Abstr. 835/1956) curves are obtained to exhibit the time-variations of intensity of two O I emissions at 6300 and 6363 A along the NW, N, and S horizons at the Pic du Midi on the night of 9-10 April, 1956. Morning and evening twilight effects are quite similar, and, from a study of the zenith–horizon intensity ratio, the altitudes of emission deduced from the measures lie between 73 and 101 km, i.e. somewhat lower than the adopted value of 110 km. D.R.Barber

551.521.326 : 535.33

5763. A PHOTOELECTRIC STUDY OF THE SPECTRUM OF THE NIGHT SKY BETWEEN 0.7 AND 1.1μ. M.Dufay.
C.R. Acad. Sci.(Paris), Vol. 244, No. 3, 364-7 (Jan. 14, 1957). In French.

The nightglow spectrum has been studied using a mirror-grating monochromator, and refrigerated photomultiplier with maximum spectral sensitivity at 0.88μ. A typical record obtain on 12th Nov. 1956 is reproduced. Preliminary results suggest that with some improvements in the reflecting surfaces, and resolution of the monochromator, instantaneous records not inferior to those previously obtained photographically with exposures of more than 20 hours should be possible. D.R.Barber

551.521.326 : 535.333

HERZBERG OXYGEN BANDS IN "AIR" AFTERGLOWS AND THE NIGHT AIRGLOW. See Abstr. 5166

551.521.6

5764. INFRARED EMISSION SPECTRA OF THE ATMOSPHERE BETWEEN 14.5μ and 22.5μ. D.E.Burch and J.H.Shaw.
J. Opt. Soc. Amer., Vol. 47, No. 3, 227-9 (March, 1957).

The atmospheric emission spectrum has been extended from 15μ to 22.5μ. Measurements made at Sacremento Peak, New Mexico are described and the emission features identified by comparison with absorption spectra of various atmospheric gases obtained in the laboratory. An asymmetry in the emission spectrum of the clear sky has been observed. A.

551.524.3 : 536.2.02

DIURNAL TEMPERATURE WAVES IN AIR. See Abstr. 5262

551.524.34

5765. STATISTICAL ANALYSIS OF AUSTRALIAN TEMPERATURE DATA. S.C.Das.
Austral. J. Phys., Vol. 9, No. 4, 542-4 (Dec., 1956).

The mean summer maximum temperatures of five Australian inland localities for a period of 65 years from 1891 to 1955 are analysed and it is shown that the temperatures have an overall parabolic trend. A.

551.555.9

5766. WIND PROFILES OVER THE SEA AND THE DRAG AT THE SEA SURFACE. E.L.Deacon, P.A.Sheppard and E.K.Webb.
Austral. J. Phys., Vol. 9, No. 4, 511-41 (Dec., 1956).

Wind speeds were measured at heights up to 13 m over the sea by means of anemometers mounted on a mast attached to the jib-boom of a small vessel and another on the foremast cross-trees. The vertical temperature gradient and air/sea temperature differences were also observed. On some occasions wind and temperature structures were explored up to 80-100 m by kite balloon. A method of observation was devised whereby the effect of the ship's hull on the wind speeds was eliminated and from the corrected profiles surface drag coefficients were calculated. For neutral conditions and fetch of wind over the sea of 20-40 km it is found that the drag coefficient (for 10 m reference height) is about 0.0010 in light winds rising to about 0.0021 at wind speeds from 10 to 15 m/sec. The drag coefficient is probably rather sensitive to stability variations, increasing particularly in the direction of instability, but the effects of variation in fetch of the wind over water are much less evident. In proximity to shallow water the drag coefficient increases appreciably. A.

551.577.37 : 523.53

5767. A RELATION BETWEEN SNOW COVER, CIRRUS CLOUD, AND FREEZING NUCLEI IN THE ATMOSPHERE. E.G.Bowen.
Austral. J. Phys., Vol. 9, No. 4, 545-51 (Dec., 1956).

It is reasonable to suppose that observations like that of cirrus cloud in the upper air and heavy falls of snow in relatively warm latitudes correspond to the presence of a large number of freezing nuclei in the atmosphere. A 300-year record of snow covering the ground at Tokyo and a 10-year record of cirrus cloud in Western Australia are examined and compared with one year's measurement of freezing nucleus concentration. The curves show a high degree of correlation, and all three tend to maximize on certain calendar dates. These dates are nearly identical with those on which singularities occur in world rainfall. It has previously been suggested that this phenomenon is due to the nucleating effect of dust from meteor showers. The record of snow cover at Tokyo for the three days December 29, 30, and 31 is examined separately and found to show a distinct recurrence tendency, which, over the 300 years of record, is identical in period and phase with that of the Bielid meteor shower. A.

551.577.37 : 523.53

5768. JANUARY FREEZING NUCLEUS MEASUREMENTS. E.G.Bowen.
Austral. J. Phys., Vol. 9, No. 4, 552-5 (Dec., 1956).

Measurements of the concentration of freezing nuclei in the atmosphere have been made in widely separated parts of the globe during January in one or more of the three successive years 1954, 1955, and 1956. The results of all three sets of observations are summarized and it is shown that high freezing nucleus counts tend to occur on dates which are identical or nearly identical with those on which unusually heavy falls of rain have previously been shown to occur. The results are discussed in relation to the possible connection between meteoritic dust and world rainfall. A.

551.577.37 : 523.53

5769. COUNTS OF ATMOSPHERIC FREEZING NUCLEI AT PRETORIA, JANUARY 1956. S.C.Mossop, A.E.Carte and K.J.Heffernan.
Austral. J. Phys., Vol. 9, No. 4, 556-60 (Dec., 1956).

An account is given of freezing nucleus measurements made in aircraft at Pretoria, South Africa, during the month of January 1956. The measurements showed variations from day to day, which are discussed in relation to the prevailing weather situation. The possible connection with particles from meteor showers is touched upon. A.

551.577.37 : 523.53

5770. COUNTS OF ATMOSPHERIC FREEZING NUCLEI AT CARNARVON, WESTERN AUSTRALIA, JANUARY 1956. E.K.Bigg.
Austral. J. Phys., Vol. 9, No. 4, 561-5 (Dec., 1956).

A new instrument for measuring freezing nucleus concentration is described, and an account given of a series of measurements made at Carnarvon in Western Australia during January 1956. The measurements were made on the ground in marine air with a long travel over the Indian Ocean and are thought to be free from contamination by terrestrial dust and smoke from industrial sources. The measurements showed distinct maxima on dates which are identical or nearly identical with those expected from Bowen's meteor theory. A.

551.577.37 : 523.5

5771. COUNTS OF ATMOSPHERIC FREEZING NUCLEI AT PALO ALTO, CALIFORNIA, JANUARY 1956. R.N.Bracewell.
Austral. J. Phys., Vol. 9, No. 4, 566-8 (Dec., 1956).

Measurements of freezing nucleus concentration were made at Palo Alto, California, each day during January 1956. They show maxima on two out of the three dates anticipated from the meteor theory. A.

551.594.14 : 518.

A HIGH-SPEED COMPUTER FOR PREDICTING RADIOACTIV FALLOUT. See Abstr. 4964

551.594.21 : 551.576.1

5772. COMMENTS ON "INITIAL ELECTRIFICATION PROCESSES IN THUNDERSTORMS". H.Appleman; R.Gunn.
J. Meteorol., Vol. 14, No. 1, 89, 89-90 (Feb., 1957).
See Abstr. 8529 (1956).

551.594.21

5773. SOME TECHNIQUES FOR LOCATING THUNDERSTORMS FROM A SINGLE OBSERVING STATION. E.T.Pierce.
"Vistas in Astronomy", Volume II, 850-5. See Abstr. 10 (1957).

BIOLOGY 57/59

578.088.2

5774. COMMENTS ON "MECHANICAL MECHANISM OF DESTRUCTIVE EFFECTS OF SOUND ON TISSUE". F.Dunn.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 395-6 (March, 1957).

A recently proposed theory (Abstr. 846/1956) to explain some of the nonthermal, non-cavitation effects of intense high-frequency sound on living tissue is discussed in the light of more recent experiments. It is concluded that the assumption of the theory that the observed effects are caused by unidirectional forces (proportional to the square of the particle velocity amplitude) of the acoustic field which create sufficiently great displacements in structural members of the tissue to produce elastic failure, is not supported by experimental results. A.

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

61

612.843 : 778.3

5775. FUNDUS CAMERA CONSTRUCTED BY THE SOCIÉTÉ OPTIQUE ET PRÉCISION DE LEVALLOIS.
Rev. Opt., Vol. 35, No. 11, 590-2 (Nov., 1956). In French.

A description is given of a modified form of the Nordenson camera, which embodies flash photography. R.A.Weale

612.843.613

5776. RELATION OF THRESHOLD CRITERION TO THE FUNCTIONAL RECEPTORS OF THE EYE. J.L.Brown, M.P.Kuhns and H.E.Adler.
J. Opt Soc. Amer., Vol. 47, No. 3, 198-204 (March, 1957).

Luminance thresholds for the resolution of parallel line grating test patterns were determined by the method of constant stimuli. Measurements were made in the dark-adapted eye. Thresholds were determined with each of eight selected colour filters and also with Wratten neutral tint filters. Seven gratings were used which required visual actuities from 0.042 to 0.625. With gratings requiring a high order of visual acuity, minimum luminances for resolution of a grating are very nearly the same for all the colour filters. As visual acuity requirements are decreased, however, luminance thresholds determined with red filters become higher relative to thresholds determined with other filters. Luminance thresholds with blue filters become lower relative to thresholds obtained with other filters. These results are interpreted to indicate that changes in the threshold criterion may result in changes in the character of visual function from rod function through mesopic function to cone function even though the eye remains dark-adapted. In situations where an individual is adapted to a visual field of low over-all luminance and must periodically, in short glimpses, read visual displays at higher levels of illumination, the appropriate specification of the relative effectiveness of illumination wavelengths will depend on the visual acuity required to read the display. A.

612.85

5777. AUDITORY REACTION TIME AS A FUNCTION OF FREQUENCY OF THE SIGNAL TONE. M.S.Prakash Rao and N.A.Nayak.
Curr. Sci., Vol. 25, No. 8, 255 (Aug., 1956).

10 listeners pressed the key of an electronic timing device upon first hearing tones ranging in frequency from 600 to 15 000 c/s. Analysis of variance of the results showed that the shortest reaction times were obtained in the band 1500 to 4000 c/s, and the minimum reaction time was 136 milliseconds. D.J.Hall

612.855

5778. SOME MEASUREMENTS OF THE IMPEDANCE AT THE EARDRUM. J.Zwislocki.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 349-56 (March, 1957).

Three methods are described for measuring the impedance at the eardrum. Two methods are psychophysical and one is purely physical. Although the physical method seems to be more appropriate for this kind of measurement, all three methods yield comparable results. The final results agree with some of the measurements made in the past on the reactance at the eardrum up to 1000 c/s. They disagree on reactance above 1000 c/s and on resistance. The new data seem to fit the general picture of sound conduction in the ear better than did values obtained earlier. They could lead to corrections in the coupler cavities used for miniature earphones and in calculations on the sound attenuation afforded by some ear protectors. A.

612.858.7

5779. CONFIRMATION OF THE NORMAL THRESHOLD FOR SPEECH ON C.I.D. AUDITORY TEST W-2. J.F.Corso.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 368-70 (March, 1957).

This study was undertaken to determine the threshold for speech intelligibility for normal ears on the Central Institute for the Deaf (C.I.D.) Auditory Test W-2. Data were collected on both right and left ears of 139 subjects, ages 18 to 24 years inclusive, showing negative otological findings, a maximal pure tone hearing loss of 5 dB at 500, 1000, or 2000 c/s, and a history of minimal noise exposure. The obtained mean threshold for speech, for all ears combined (N = 278), was 18.55 dB re 0.0002 dyne/cm^2, with a standard deviation of 4.46 dB. These results confirm the normal value for the threshold of intelligibility for the spondaic words of C.I.D. Auditory Test W-2. A.

612.858.7

5780. METHOD OF "SINGLE DESCENT" IN GROUP AUDIOMETRY. W.D.Ward.
J. Acoust. Soc. Amer., Vol. 29, No. 3, 371-6 (March, 1957).

Various methods for determining threshold in a group testing situation were compared. No significant differences in reliability were found between the method of adjustment (either direct or indirect) and the method of "single descent", in which the listener presses a button "just when the beeps disappear". However, the method of single descent is independent of individual differences in adjustment time and requires less apparatus. Thresholds determined by single descent were affected only slightly by rate of descent, starting level and practice factors. A comparison between single descent and the standard clinical technique showed the thresholds to be valid. Field performance of the method, in a 10-man group audiometer, has fulfilled expectations from the pilot studies. A.

TECHNIQUE. MATERIALS 62/69

621.9.01 : 534.321.9

5781. SPECIAL THEORY OF ULTRASONIC MACHINING. G.E.Miller.
J. appl. Phys., Vol. 28, No. 2, 149-56 (Feb., 1957).

A model is proposed for the mechanism of material removal in ultrasonic machining. From this model and fundamental physical principles, a machining rate equation is derived for the special case where solid, circular tools are used in conjunction with a puddled slurry. A comparison of the predictions of the theory with the experimental data shows that the theory gives the correct relationship between the machining rate that the variables involved in the machining process. Suggestions for the improvement of the ultrasonic machining process are presented, and the method to be used in generalizing the theory is outlined. The poor reproducibility of the machining rate measurements is explained on the basis of the machining rate equation. A.

681.2 :53.084

5782. FUSED-QUARTZ FIBERS. A SURVEY OF PROPERTIES, APPLICATIONS, AND PRODUCTION METHODS. N.J.Tighe.
Circ. Nat. Bur. Stand., No. 569, 26 pp. (1956).

This survey covers literature up to 1953 inclusive.
325 references.

PHOTOGRAPHY 77

771.534.5

5783. EXPERIMENTAL STUDY OF THE SPECTRUM OF LOCAL TRANSPARENCIES IN A PHOTOGRAPHIC FILM UNIFORMLY EXPOSED. M.Savelli.
C.R. Acad. Sci. (Paris), Vol. 244, No. 7, 871-3 (Feb. 11, 1957). In French.

The frequency response of the granularity of a photographic film uniformly exposed has been measured for three exposures. The three curves are similar in shape, practically constant at low frequencies, falling to zero at higher frequencies. R.W.Fish

771.53

5784. ON THE QUESTION OF A AgBr STRUCTURE ALTERATIC ON THE FORMATION OF THE LATENT IMAGE. W.Waidelich.
Z. Phys., Vol. 146, No. 4, 505-14 (1956). In German.

To test the theory that the latent image consists of regions in which the rocksalt lattice of AgBr is converted to the zinc blende structure, Debye–Scherrer photographs were made in monochromatic X-rays using unexposed and exposed films kept in motion to avoid excessive X-ray exposure. No trace of zinc blende structur was detected, hence the maximum size of any regions of this type i estimated to be 3 to 5 lattice spacings. S.T.Henderso

778.3

5785. THE DETERMINATION OF LINEAR DISTORTION IN NUCLEAR EMULSIONS. A.J.Apostolakis and J.V.Major.
Brit. J. appl. Phys., Vol. 8, No. 1, 9-11 (Jan., 1957).

The ratio of the linear distortion vector to the curvature distortion vector is found to be (2.03 ± 0.03) within the temperature range (for hot-stage development), of 15-24° C. The vectors are found to be in opposite directions. Some consequences of distortio are considered. A

778.3

5786. DEPENDENCE OF THE TAPER LENGTH OF EMULSION TRACKS ON PARTICLE CHARGE. D.V.Viktorov and M.Z.Maksimov.
Zh. éksper. teor. Fiz., Vol. 32, No. 1, 135-8 (1957). In Russian.

Proceeding from Freier's hypothesis that taper length of trac is due to decrease of specific energy losses it is suggested that an increase of the quantum yield of developed grains with increasing energy absorbed by the photographic layer takes place in nuclear and also in X-ray emulsions. The energies at which this phenome begins are approximately the same. The dependence of the taper length on the particle charge has been computed. The calculations agree satisfactorily with available experimental data.

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